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TRENDS IN CONTINENTAL DEFENCE: A CANADIAN PERSPECTIVE

by
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Preface

During the Parliamentary Committee hearings which preceded the final reading of the Bill establishing the Institute, witnesses agreed that one of the most useful tasks which such an organization could perform would be to sponsor academic research on matters related to peace and security. Such research would provide information and ideas on the basis of which those interested could develop informed opinions as to the best ways of reducing international tension. It was hoped that such research would not be confined to technical or to strictly military matters but would cast a wider net covering some of the underlying causes of conflict and international instability. It was also suggested that it should focus on matters of particular relevance and interest to Canada.

Whereas our first paper was concerned with an underlying cause of international instability, namely US-Soviet rivalry in the Caribbean, this, the second in the series, is devoted to more technical and strictly military matters. It has been prepared by the Institute's research director, Professor David Cox, and is largely based on research which he undertook at the request of the Secretary of State for External Affairs, Joe Clark. Decisions concerning Canada's role in the defence of North America are likely to shape our most important bilateral relationship and even to affect Canada's identity as a nation. The subject matter is thus of great practical concern to those responsible for the direction of long-term defence policy, as well as to the Canadian public.

Geoffrey Pearson

Geoffrey Pearson
Executive Director

Trends in Continental Defence: A Canadian Perspective

by
David Cox

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EXECUTIVE SUMMARY

The purpose of this paper is to examine the evolving technologies which will determine the nature of the threat and the prospects for defence in matters relating to continental defence. It also considers the options facing Canada in its response to this changing security environment.

The paper begins with a brief review of the historical pattern of Canadian/US co-operation in air defence, emphasizing the linkage between US policy on air defence and the larger doctrines of strategic deterrence, nuclear war-fighting, and the search for defence against inter-continental ballistic missiles.

It then considers the possible impact on air defence, and Canada's part therein, of various arms control scenarios. The conclusion is that under some of the proposals for deep cuts, as discussed in Geneva and Reykjavik, bombers and cruise missiles would become a more significant part of Soviet strategic forces than they have in the past and are at present, probably encouraging in turn a greater concern with defence against bombers and cruise missiles. Extrapolation from US cruise missile developments, combined with known information about Soviet programmes, suggests that long-range cruise missiles will play an increasing role in the strategic force inventories. Although this is considered to be an important development, the main deployment areas are thought likely to be in the Atlantic and Pacific approaches to North America, and not primarily in the Arctic, as some analysts have suggested.

On the other hand, *transit* through the Canadian Arctic, including the North-West passage, is considered likely to increase, with the danger that the area will be increasingly militarized with or, more likely, without Canadian approval.

The linkage between SDI and air defence is also discussed. The conclusion drawn from the survey of SDI developments is that while there are many possibilities that would involve Canada in US efforts to deploy a strategic defence, almost all these possibilities will remain a matter of speculation until a comprehensive systems design for SDI is completed. On the other hand, the related Air Defence Initiative may produce dramatic changes in air defence in a much shorter time frame, including the possibility that supersonic interceptor missiles, airborne and space-based sensors, and new battle management systems will be feasible.

The study then considers existing Canadian policy on surveillance, and particularly the issues surrounding the North Warning System. It concludes that serious doubts exist about the value of the currently planned location of the North Warning System, particularly if it is viewed as a primary means for the national surveillance of Canadian territory. It suggests that serious thought be given to the proposals for re-assessment of the second phase and for re-location of the line. It also suggests that more consideration be given to a national space-based surveillance sys-

tem, since, of all the systems considered, this is the one which would provide the most extensive coverage of Canadian territory and promises the greatest development potential to Canadian industry.

Considering the weapons procurement options facing Canada, the study proposes that the guiding precept should be the commitment to support surveillance and patrol capabilities, but that Canada should not directly procure weapons systems designed for nuclear war-fighting purposes. In regard to the Arctic, the study distinguishes the Arctic Ocean from the inland waters of the Canadian archipelago. For the latter, it proposes a unilateral 'keep out zone' for submarines, monitored by a Canadian sonar surveillance system and enforced, if necessary, by mining the deep channels of the archipelago. In the Arctic Ocean, it is proposed that Canada limit itself to modest surveillance activities using passive systems. This proposal would obviate the need for nuclear submarines, and open the possibility that Canada might acquire a range of surveillance capabilities and a fleet of diesel submarines without the relinquishment of military commitments in the European theatre.

The conclusions return to some earlier themes. Rapid technological change will require fundamental decisions about the part Canada is to play in continental defence. A clear policy will be required from which procurement decisions follow. The policy proposed is to limit Canadian involvement to activities which would provide peacetime surveillance and crisis stability, and to desist from programmes which, in the last resort, assume the possibility of nuclear war-fighting.

I.

INTRODUCTION*

This paper addresses some of the changing issues in continental defence, particularly as they affect Canada. It is now a commonplace to note that the strategic debate — not yet reflected in the force postures of the superpowers — has shifted inexorably to include defensive force deployments in the calculus of deterrence.[1] This shift has been accelerated and politicized by the Strategic Defense Initiative (SDI), but it would be wrong to assume that SDI is the sole cause of the shift. Although it was given momentum by President Reagan's statement of 23 March 1983, the search for a defence against ballistic missiles long ante-dates SDI. In a parallel development, dissatisfaction with mutual assured destruction had steadily increased throughout the 1970s, and was voiced by critics ranging across the political spectrum.[2]

This debate clearly has implications for Canadian-US co-operation in North American defence. But there are additional factors which bear upon this co-operation. The first is the relatively swift emergence of cruise missiles as an element in strategic forces, able to combine an elusive second strike capability with the added dimension of surprise attack. The continuing rapid development of Soviet air-launched and submarine-launched cruise missile programmes is of particular interest in this respect.

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* I am grateful to a number of people in Ottawa and Washington who have given freely of their time and knowledge in response to my various questions about submarine warfare and defence technologies. In particular, I wish to acknowledge the contributions to an earlier version of this paper of Ronald Purver and Lawrence Hagen while in their former positions with the Canadian Centre for Arms Control and Disarmament. Jane Boulden, of CIIPS, provided substantial assistance in the construction of the tables. Of course, none of the above are accountable for the information, analysis and viewpoints expressed in the paper, for which I am solely responsible.

[1] To sample the debate, see eds. Ashton B. Carter and David N. Schwartz, *Ballistic Missile Defence*, Brookings Institution, Washington, D.C., 1983, especially Chapter 11, "Reactions and Perspectives: Nine Personal Views". For a strong statement of support for strategic defence, see Robert Jastrow, *How to Make Nuclear Weapons Obsolete* (Little, Brown & Co., Toronto 1985); the debate can also be followed in almost all recent issues of *International Security*.

[2] For example, see the debate between Paul Nitze, "Assuring Strategic Stability in an Era of Detente", *Foreign Affairs*, 54, January 1976, pp. 207-32 and Jan M. Lodal, "Assuring Strategic Stability: An Alternative View", *Foreign Affairs*, 54, April 1976, pp. 462-81. For the criticism from the left, see Jonathan Schell, *The Fate of the Earth* (Alfred A. Knopf, N.Y., 1982). In their book *The Death of Deterrence* (CND Publications, London 1984), Malcolm Dando and Paul Rogers wrote: "stable deterrence through mutual assured destruction, if it ever existed, will soon be finished". More cynically, perhaps, Albert Carnesale commented in testimony before the House Committee on Armed Services, H.A.S.C. 99-18, Hearings Before the Special Panel on Arms Control and Disarmament, p. 276: "... there are many of us who like assured destruction, but I don't know anybody who likes mutual assured destruction."

The second is the fact that, during the mid 60s, the United States and Canada, co-operating in the North American Air Defence Command (NORAD), allowed active defence against the manned bomber (the air breathing threat) to decline to a minimal level. As indicated in the next section, the justification for this was the marginal incremental nuclear threat posed by the Soviet strategic bomber force. With time, however, the forces committed to this activity have required replacement if only because of obsolescence, thus drawing attention, particularly in the United States, to the absence of adequate defences against bombers and cruise missiles. In the United States debate, but not in Canada, much has been made of the apparent contrast between the lack of North American defences and the major Soviet resources committed to the task of air defence. Perhaps as a consequence of this, in the late 70s, pressure increased in Congress for a study of air defence, and Congress took a strong interest in the Air Defence Master Plan produced in 1982.[3]

Finally, the Distant Early Warning (DEW) line, deployed in 1957 across the 70th parallel in Canada, and linked to other radars across the Pacific and the Atlantic, has also become obsolescent at a time when increased research and development in surveillance technologies is taking place in the United States. Any air-based or space-based surveillance system designed to cover the northern approaches to the continental United States has military and political implications for Canada, and is bound to influence Canadian decisions concerning capital equipment.

All of these factors have combined to raise the political and strategic profile of continental defence, and of the US-Canadian partnership therein, posing defence policy issues for Canada which are perhaps reminiscent of those in the early 60s, and emerging at a time when severe constraints on the Canadian defence budget tighten the choice between equally plausible options in defence procurement. This paper seeks to clarify these issues and to identify the major choices facing the Canadian Government. In particular, it addresses the following five broad areas of concern:

- the historic pattern of relations between strategic offensive weapons and strategic defence;
- trends in superpower offensive force deployments, paying particular

[3] At the time of the 1981 NORAD renewal the two countries issued a "Joint Policy Statement on the Air Defence of North America" which affirmed that the two countries "should be considered as a single entity for purposes of air defence". The North America Air Defense Master Plan (NAADMP) was distributed to the relevant agencies of the US Government on 28 January 1982. The Presidential programme therein called for "the resolution of existing surveillance deficiencies by deployment of new ground radar and employment of additional airborne radar sensors. Coverage will be expanded by Over-the-Horizon Backscatter (OTH-B) radars and improved microwave radar systems. Also, additional AWACS aircraft are to be procured for North American air defence to augment ground-based radars in peacetime and to provide surveillance and control interceptors in wartime. Active air defence capability will be significantly enhanced by replacing five squadrons of aging F-106 fighter with F-15s". To date, the United States has not acquired the additional AWACS aircraft, but other elements of NAADMP have proceeded.

attention to possible changes stemming from the uncertainties surrounding SALT II, and to the respective proposals for arms reductions in the current Geneva negotiations;
- the implications of current programmes and uncertainties in the Strategic Defense Initiative;
- the modernization of surveillance systems; and
- the costs and opportunity costs involved in a larger commitment to continental defence.

II.

HISTORIC PATTERNS OF OFFENCE/DEFENCE INTERACTIONS

Canada's post-war experience in sharing responsibility for continental defence continues to be relevant and instructive despite changes in technology and doctrine. In Canada, scholarly research and debate has tended to focus on the public disputes between Canada and the United States, particularly but not exclusively during the Diefenbaker period. More recently, however, greater understanding of US strategic doctrines has been considerably enhanced by evidence bearing on the strategic plans of Strategic Air Command (SAC), and on the Canadian response to those plans.[1]

Although not central to this analysis, certain aspects of this experience continue to be relevant to contemporary issues, in particular

a. the rationale for northern-based surveillance systems;
b. the lessons from the deployment of extensive air defence interceptor squadrons and control systems in the period 1957-63; and
c. the continuity of American strategic operational doctrine which calls for counter-force nuclear attacks on hostile offensive nuclear forces.

a. **Northern-Based Surveillance Systems**

Since the late 1940s, when the Soviet Union first developed a bomber with intercontinental range, the Canadian North has been of strategic importance to US planners concerned with surveillance and early warning. In response, Canadian policies have sought to balance two competing concerns: on the one hand, the maintenance of Canadian sovereignty in the North, which, typically, has induced considerable reluctance to countenance proposals for any increasing US military presence there; and on the other, the need of the United States for early warning of a strategic bomber attack in order to protect its own strategic forces.

In the decision to develop the DEW and Mid-Canada lines in the mid 1950s, two distinct objectives were involved. The first was *early warning*. The creation of a radar warning line far to the North, with associated picket ships and surveillance aircraft, was intended to ensure that the US

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[1] See in particular David Alan Rosenberg, "A Smoking Radiating Ruin at the End of the Two Hours: Documents on American Plans for Nuclear War with the Soviet Union 1954-55" *International Security* 6:3, Winter 1981-82, pp. 3-17; Rosenberg, "The Origin of Overkill: Nuclear Weapons and American Strategy, 1945-1960", *International Security* 7:4, Spring 1983, pp. 3-71; and Desmond Ball, *Targeting for Strategic Deterrence*, Adelphi Paper Number 185, 1983.
For the impact of these doctrines on Canada and Canadian-US relations, see David Cox, *Canada and Norad, 1958-1978: A Cautionary Retrospective*, Aurora Paper Number 1, Canadian Centre for Arms Control and Disarmament, Ottawa, 1985.

retaliatory force, then consisting of nuclear-armed bombers, would have sufficient notice to be able to fuel, arm, and disperse before their bases were attacked. Against the earlier versions of Soviet bombers, the DEW line gave up to six-hour's warning of such an attack, thereby permitting adequate response time for both retaliatory bombers and interceptors. The second objective was *territorial defence*, which included defence both of population and of industrial facilities. The former objective placed primary emphasis on a passive warning system, the latter required extensive active defence (interceptor aircraft, air-to-air missiles, and tracking and control systems).

In considering contemporary deployment policies, it is helpful to retain the distinction between these two objectives. The need for early warning to allow the arming and dispersal of B-52 bomber forces has changed because, given the ability of the Soviet Union to attack military targets using inter-continental ballistic missiles (ICBMs) or submarine-launched ballistic missiles (SLBMs), the warning time for B-52 bases has been reduced to 15 minutes or less. In order to ensure a retaliatory capability, therefore, elements of the B-52 force must be either in the air, or at a high state of alert. Consequently, if the only purpose of early warning radar is to ensure adequate time for retaliatory forces to disperse from their bases, several hours of warning is unnecessary although, of course, some warning time in excess of that permitted by SLBM attack is desirable.

With regard to *active* defence measures, early warning is also valuable for interceptors, but early warning radars have not in the past possessed a tracking (as opposed to detection) capability which made feasible fighter interception of incoming bombers in the far North. With the DEW line technology, the so-called combat zone — "the area encompassed by the maximum limit of contiguous radar coverage around the US and Canadian targets within which the air battle is conducted"[5] — remained close to the areas to be defended, namely the urban and military targets of the United States and Canada. Although the United States Air Force (USAF) has always been interested in the northward expansion of the combat zone, only with the development of long-range air-launched cruise missiles has there been serious consideration of the creation of a combat zone in the far North.

The DEW line continued to be useful as a northern surveillance system even though its initial purpose — to allow the dispersal of the retaliatory forces of the United States — was made redundant, particularly by the development of ballistic missiles. It had a quite different function in that it offered a surveillance system, albeit at an elementary level, for Canadian airspace in the North. Since the 'envelope' of the DEW line radars is limited, however, DEW line capabilities permit only limited peacetime surveillance of northern Canadian air space.

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[5] Cox, *op. cit*, p. 13 and pp. 18-22 for a discussion of the US attempt to create CADIN — Continental Air Defence Integration North.

b. **The Experience With Active Air Defence 1957-1963**

At the time of the establishment of NORAD, first informally in 1957 and then by formal agreement in 1958, large numbers of US and Canadian interceptor aircraft were deployed for active defence. Although the imminent deployment of Soviet ballistic missiles was recognized, American defence planners continued to believe that the bomber would be the main threat, at least until 1963. Strenuous efforts were made, therefore, to create an active air defence system that would be capable of coping with a force of several hundred attacking bombers.

Although the number of heavy bombers deployed by the Soviet Union was seriously overestimated, the bomber threat was nevertheless a considerable one since active air defence could not in itself ensure an adequate level of protection for civilian populations. In the United States this led to a period of interest in civil defence, which was largely abandoned when it became clear that the emergency evacuation of cities was impractical.

The limitations of a purely defensive strategy were further exposed in studies conducted in 1964 for the Joint Chiefs of Staff, at the request of Secretary of Defense Robert McNamara. These studies suggested that a determined Soviet bomber and missile attack would result in between 90 and 120 million American casualties. Calculations indicated that the existing air defence (still heavily deployed) would reduce those casualties by only 1.5 million or less, and even this figure was questionable since there was considerable uncertainty that they could identify the figure at all. In these circumstances, McNamara argued that a phase-down of the interceptor force could be achieved without any significant loss of damage-limiting capability, and that a smaller force more skillfully deployed would still inhibit any Soviet disposition to take advantage of the diminished air defence.[6] There is no reason to suppose that this situation has changed and that an active air defence programme would protect a greater number of civilians at the present time, or in any foreseeable future scenario short of the development of a high confidence ballistic missile defence (BMD) of populations.

In response to this situation, McNamara propounded the doctrine of mutual assured destruction (MAD) which, until recently, has been the articulated basis for most US strategic posture statements, and which has been accepted as such by successive Canadian governments. McNamara's concept of assured destruction was based on the calculation that American strategic forces could absorb a Soviet first strike and still impose such levels of destruction on the Soviet Union as to constitute unacceptable damage, thus deterring the attacker from initiating the exchange.

[6] McNamara's analysis can be found in "Recommended FY 1966-70 Programs for Strategic Offensive Forces, Continental Air and Missile Defense Forces, and Civil Defense", Memorandum to the President, 3 December 1964. Conceptually, it remains relevant to the current situation.

In itself, the concept of mutual assured destruction leaves little or no room for continental defence, since it is essentially an agreement to accept mutual vulnerability as the basis for stability. Even with McNamara, however, it was accompanied by a corollary argument: in the event that deterrence failed, the task of defence was to limit damage to the American population and to industrial centres. Such damage limitation could be achieved in a variety of ways such as passive defence through a shelter programme, but it also involved nuclear attacks on Soviet offensive forces by American strategic offensive forces.

In this respect, active air defence complemented the targeting doctrines of Strategic Air Command. SAC operational plans called for massive, counter-force strikes against Soviet *strategic* forces. If successful, such strikes would have so diminished the attacking Soviet bomber force that air defence might then have been effective enough to reduce civilian casualties to an acceptable level. In sum, the operational doctrines of the 1950s and 1960s recognized that active defence was a logical adjunct to counter-force nuclear strikes against Soviet missiles and bomber forces. Left undefined in these doctrines was the issue as to whether such counter-force strikes would be pre-emptive, or whether they would be launched only after the Soviet Union had initiated nuclear hostilities.

c. **The Continuity of US Strategic Doctrine**

It is the last point that provides the continuity between the McNamara doctrine, the earlier SAC operational doctrines which called for counter-force strikes against Soviet strategic nuclear forces, and more recent issues concerning policies of nuclear war fighting and strategic defence. Despite some ongoing controversies, the basic ambiguity — mutual assured destruction, but counter-force strikes if deterrence failed — was continued by successive Secretaries of Defense throughout the sixties and seventies. Since it is well understood that the advantage, particularly in submarine warfare, goes to the party that 'shoots first', the inconsistency in this position is the core of the strategic dilemma.

In July 1980 President Carter issued Presidential Directive (PD) 59, which, in the eyes of some observers, marked a significant change in American policy.[7] Although PD 59 may have broken new ground in explicitly contemplating decapitating strikes and prolonged but selective nuclear exchanges, it is not obvious that it marked a dramatic change in targeting doctrine. In 1980 the intent to achieve damage limitation by "blunting" Soviet offensive forces was not put in those terms, but the commitment was unchanged. Without defence against ballistic missiles, however, counter-force targeting was unlikely to protect population and could not be seen, therefore, as a doctrinal alternative to mutual vulnerability. In turn, lacking ballistic missile defence (BMD), the allocation

[7] For a Canadian view of the policy implications, see Douglas Ross, "American Nuclear Revisionism, Canadian Strategic Interests, and the Renewal of NORAD," *Behind the Headlines* (CIIA, Toronto), Vol. XXXIX, Number 6, 1982.

of resources to an active air defence system continued to be cost ineffective. It may be useful to note, for example, that PD 59 was not accompanied by any significant operational change in the US Air Force approach to air defence.

To emphasize the continuity in these central doctrines, we might note finally that, in 1982, National Security Decision Directive (NSDD) 13 appeared to confirm President Reagan's acceptance of PD 59 and the assumptions on which it was based.[8]

In sum, lacking defences against ballistic missiles, since the early 60s bomber defences beyond a prudent minimum have been regarded as a waste of resources. With allowance made for obsolescence, this situation persists up to the present. It seems evident, however, that if the situation were to change and some form of BMD to be deployed, earlier strategic logic would re-assert itself: that is, terminal BMD or area BMD will be more effective if preceded by counter-force strikes at hostile strategic nuclear forces. In a fundamental sense, President Reagan's strategic defense initiative might replace counter-force *nuclear* attacks with non-nuclear, boost phase intercept and other BMD systems which do not raise the question of pre-emption. In both cases, however, the link to air defence is the same. If boost phase intercept functionally replaces counter-force nuclear targeting, it is logical to assume that it would be accompanied by renewed emphasis on air defence, and possibly civil defence as well. In the meantime, and granted that high confidence boost-phase intercept is still a very distant prospect, *partial* ballistic missile defences, which are much more likely to be deployed, clearly would be more effective if combined with counter-force nuclear strikes.

[8] For a discussion of PD59 and NSSD-13, see Jeffrey Richelson, "Population Targeting and US Strategic Doctrine", *Journal of Strategic Studies*, March 1985, Vol. 8, pp. 5-21.

III.

CHANGES IN SOVIET OFFENSIVE FORCE STRUCTURES AND ARMS CONTROL REGIMES

The Soviet strategic forces which most directly affect the Canadian role in continental defence are the following: bombers, bombers armed with air-launched cruise missiles (ALCMs), ballistic missile carrying submarines (SSBNs), particularly if positioned off the Canadian coasts or in the Canadian Arctic, and similarly positioned nuclear attack submarines (SSNs) equipped with long-range cruise missiles. Of course, in addition to these systems, which raise quite specific issues for Canadian defence policy, Canada has long recognized the need for surveillance and early warning of ballistic missile attack, but has had only a marginal role in the development and operation of ballistic missile early warning systems (see section V).

In considering the future development of these strategic forces, two frameworks are relevant: the SALT agreements, which have channelled offensive force deployments, and the Geneva negotiations, in which the respective proposals of the United States and the Soviet Union offer important insights into the future place of bombers and submarines in strategic forces. The following observations focus on the present and possible future development of Soviet forces in the light of these two frameworks.

Soviet Bomber/Cruise Missile Forces

First, as Table 1 illustrates, the Soviets have not placed high value on the bomber as a strategic delivery vehicle. They made the choice more than twenty years ago to concentrate on land-based missiles at the expense of bomber forces, and, indeed, to a lesser extent, at the expense also of submarine ballistic missile forces.

The circumstantial evidence suggests that until recently this has continued to be their preferred choice. Table 2 presents an assessment of the Soviet proposal on strategic arms reductions, as initially presented at Geneva on 30 September 1985. In its various proposals, the Soviet Union has emphasized "the historically formed features of the parties' strategic forces" while seeking to some degree to respond to US concern about the counterforce capabilities of the SS-18. The lower portion of Table 2 is not a part of the Soviet proposal, but represents a plausible draw-down of their strategic forces, assuming their historic preference for maintaining a structure which emphasizes land-based missiles, and assuming also that they would wish to retain their most accurate and lethal missiles (the SS-18 and SS-19). Clearly the logic of the reductions suggests that bombers would be a quite small component of the Soviet forces that might plausibly result from the implementation of their own proposal. The Soviet proposal to ban all long-range cruise missiles (over 600 kms) is another

Table 1

Soviet Offensive Forces 1962-1986

Soviet Union
Strategic Forces

Year	ICBMs	SLBMs	Strategic bombers	Total
1962	75	some	190	
1964	190 (40%)	107 (23%)	175 (37%)	472
1966	292 (53%)	107 (19%)	155 (28%)	554
1968	858 (76%)	121 (10%)	155 (14%)	1134
1970	1513 (77%)	304 (15%)	140 (7%)	1957
1972	1527 (70.5%)	500 (23%)	140 (6.5%)	2167
1974	1618 (65%)	720 (29%)	140 (6%)	2478
1976	1477 (60%)	845 (34%)	135 (6%)	2457
1978	1400 (55%)	1028 (40%)	135 (5%)	2563
1980	1398 (54%)	1028 (40%)	156 (6%)	2582
1982	1398 (56%)	989 (40%)	105 (4%)	2492
1983	1398 (55%)	980 (39%)	143 (6%)	2521
1985	1398 (55%)	981 (38%)	173 (7%)	2552
1986	1398 (55%)	983 (39%)	160 (6%)	2541

Sources: Bruce Blair, *Strategic Command and Control*, Brookings, 1985
Soviet Military Power 1986
IISS Military Balance 1986-87

Notes

1. Backfire excluded.
2. The increase in Soviet bombers in 1985 is mainly explained by the appearance of the Bear-H; the decrease in 1986 reflects the removal from service of the older Bisons.

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indication that they have no comparative technological advantage in this field, and would like to avoid having to allocate additional resources to it. (This, of course, is not to comment on the merits of their initial proposal since, as Table 6 indicates, the preponderance of deployed Soviet sea-launched cruise missiles (SLCMs) have ranges under 600 kilometres).

By way of locating the bomber threat still further in the context of the superpowers' negotiations on arms control, Table 3 is designed to show a plausible, but of course hypothetical, development of Soviet bomber forces if Soviet force deployments were to meet the ceilings suggested by the United States in its strategic arms reduction proposal. In both its October 1985 strategic arms proposal (the response to the Soviet proposal of 30 September) and its revised proposal of July 1986, the United States

Table 2

Soviet Force Reductions Under the Soviet Proposal of 30 September 1985

(50% cut in strategic launchers, 6000 ceiling on strategic 'nuclear charges', 60% sub-ceiling on any single leg of the triad)

Current Soviet Strategic Nuclear Weapons

	Launchers	% of Total	Warheads	% of Total
ICBM	1393	(55%)	6420	(62%)
SLBM	983	(38%)	3159	(31%)
Bombers	160	(7%)	760	(7%)
	2541		10,339	

After 50% cut in launchers and 6000 warheads ceiling:

A Plausible Force Structure

Launcher ceiling — 1273	Warhead ceiling — 6,000
290 SS-18 (10 warheads)	2900
100 SS-19 (6 warheads)	600
100 SS-25	100
	3600 (60%)
150 SS-N-18 (7 warheads)	1050
80 SS-N-20 (9 warheads)	720
32 SS-N-23 (7 warheads)	224
	1996 (33%)
50 Bombers (8 warheads)	400 (7%)
718	5996

Notes:

1. Under the combined launcher and warhead ceilings, the warhead ceiling is invariably attained first. Over time, this would probably induce both sides to "de-MIRV" in order to maximize the number of launchers.
2. The number of the strategic bombers could be increased but not the number of bombs/cruise missiles carried if the 6000 warhead ceiling is imposed.

established a separate limit on strategic bombers. In both cases, and possibly again at Reykjavik, the proposed sub-ceiling was 350 heavy bombers out of a total of 1600 strategic delivery systems.

In October 1985 the United States also proposed a limit of 1500 ALCMs, increased to 2000 in the July proposal by which the US total warhead ceiling was increased to 7500, and probably reduced again to 1500 at Reykjavik when, in the first five-year term agreed upon, the respective sides agreed to 50 per cent reductions and ceilings of 1600 launchers and 6000 warheads. Sea-launched cruise missiles were not included in the US proposals.

From Table 3 it can be seen that the Soviets would need to increase production of the Bear-H at an extraordinary rate in order to achieve the 350-bomber ceiling within a five-year period, with the expectation that the older Bears and Bisons would be phased out as Bear-H and Blackjack bombers became available. Consideration of these possible deployments inevitably raises the related question of Soviet cruise missile deployments.

The Soviet AS-15 is an air-launched cruise missile with a possible range of 3000 kms.[9]. To carry this missile, US sources indicate that the Soviets have opened a new production line for the Bear-H bomber, which is thought to carry eight AS-15s. The Bear-H is a new version of an old aircraft, but is presumably adequate to the task of providing a platform for a strategic cruise missile force. The utility of the Bear-H as a platform, is of course, largely dependent on the range of the ALCM, since the Bear-H is itself a slow and vulnerable target. In any event, the slow speed of the Bear-H makes the stand-off ALCM a second-strike weapon. If the Soviets continue to produce the Bear-H, *and* deploy the new Blackjack in 1988/89 possibly as a penetrator bomber, *and* if they also continue cruise missile production at a comparable rate, they might achieve the force levels suggested in Table 3 by 1991. In comparison with the reduction levels implied in their September proposal, therefore, the first phase of the Reykjavik proposal (a five-year period, 1600 launchers, of which, following the earlier US position, 350 would be bombers) would induce the Soviets to a massive bomber and cruise missile building programme at the end of which they might still not have attained the levels contained in the Reykjavik proposal. In summary, and comparing tables 2 and 3, it is plausible to argue that, under Reykjavik and the earlier US proposals, the Soviets would be invited to build three times as many bombers carrying six times as many nuclear weapons.

Finally, estimates of Soviet force developments suggest that, *without* SALT constraints and without agreements at Geneva, Soviet offensive forces

[9] See US Senate Committee on Armed Services, Hearing 99-58, Part 7, pp. 3860-3863; US Department of Defence Appropriations for 1986, Hearings before the House of Representatives Subcommittee of the Committee on Appropriations, Part 2, pp. 908-911; Barton Wright, *World Weapon Data Base*, Institute for Defense and Disarmament Studies, 1986, pp. 468-469, 528-530.

Table 3

Highest Plausible Soviet Bomber Deployments Using US Proposal —
(350 heavy bombers of which 120 can carry ALCM, 1500 ALCM limit, 4500 ballistic missile warheads)

Year	Strategic bombers	Long-range ALCM	Gravity Bombs/ ASMs*
1986	40 Bear-H	320	—
	100 Bear-B/C/G	—	400
	20 Bison	—	40
	160	320	440
1987	80 Bear-H	640	—
	100 Bear-B/C/G	—	400
	10 Bison	—	20
	190	640	420
1988	120 Bear-H	960	—
	(Proposal limit)	—	—
	20 Blackjack	—	160
	100 Bear-B/C/G	—	400
	10 Bison	—	20
	250	960	580
1989	150 Bear-H	800	400
	40 Blackjack	240	160
	80 Bear-B/C/G	—	320
	270	1040	840
1990	170 Bear-H	640	720
	65 Blackjack	480	300
	60 Bear-B/C/G	—	240
	295	1120	1260

* ASMs are air-to-surface missiles. For the purposes of this table that includes short-range ALCMs such as the AS-3 and AS-4.

Notes:

1. Backfire excluded.
2. Bear-H assumed to carry 8 AS-15 ALCMs and to be produced at a maximum rate of 40 per year. It should be emphasized that this production rate is very high and for illustrative purposes only. The present production rate is 18 per year.
3. The Blackjack IOCs assumed to be 1988 with its primary mission as a penetrator bomber in the initial period of deployment.
4. Since Soviet bombers are only capable of carrying 8-12 ALCMs; it will be difficult for the Soviets to reach the 1500 ALCM ceiling while remaining within the 120 ALCM carrier limit. The Blackjack may be capable of carrying more than 12 ALCM (it is larger than the B-1B), but has not yet been so characterized.

would nevertheless grow in a manner compatible with that depicted in Table 3. In sum, these projections, as illustrated in Table 4, suggest that although, in an unconstrained environment, Soviet bomber forces would increase significantly in absolute numbers, they would continue to be a minor part of total Soviet offensive forces. By contrast, any plausible version of the arms reduction proposals discussed at Geneva and Reykjavik (row B in Table 4) assigns much greater *relative* importance to the bomber as an element in strategic forces.

These general observations are subject to two important further observations. First, cruise missile technology may develop in such a manner that the combination of supersonic speed and 'low observables' (Stealth) may permit pre-emptive or search-and-destroy missions. In a recent authoritative article on US defence policy, Secretary of Defense Caspar Weinberger seemed to be hinting at that possibility, when he wrote of the need to develop a capability to 'reach in' to the Soviet Union.[10] Although there is not yet the capability to provide 'real time' re-programming information to an advanced cruise missile in the terminal phase of flight and seeking, say, a moving SS-25, the great emphasis which the USAF now places on the ACM programme suggests that qualitative improvements may be only beginning. If this is the case, it is reasonable to suppose that the Soviets will follow suit, thus giving rise to difficult future questions about the adequacy of US and Canadian surveillance capabilities against stealthy bombers and cruise missiles.[11]

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[10] Caspar W. Weinberger, "US Defense Strategy", *Foreign Affairs*, Spring 1986, p. 694: "If American technology were able to create airplanes, ballistic missiles and cruise missiles essentially invisible to current Soviet radar technology, massive Soviet investments in defense against aircraft over the battlefield in Europe would become obsolete. Or, if the United States had the capability to reach into the Soviet Union and destroy selective, highly valued targets, Soviet confidence in its nuclear war-fighting plans would perforce be greatly reduced."
See also the comments of the US Under Secretary for Defense, Donald A. Hicks, "Stealth: Its Implications for the Future", Armed Forces Journal, September 1986, pp. 70-71.

[11] The North Warning System is discussed below, pp. 33-37. Some basic ideas concerning future Soviet cruise missiles can be developed from the little that is known about the US advanced cruise missile (ACM). The US programme appears to have emphasized longer-range (perhaps by developing more fuel efficient engines rather than increasing the fuel capacity), and stealth characteristics. Stealth technology also has implications for range, since its raises the possibility that the ACM would not need to be low flying: 'invisible' high altitude flight paths might at some future point make feasible intercontinental cruise missiles, thereby creating an entirely new strategic balance, and raising some difficult issues for arms control. In addition to the obvious problems of verification, the family of strategic stealth missiles and bombers is likely to require new, lower yield nuclear weapons because of payload limitations. This may be a contributing factor in the US resistance to a comprehensive test ban. The US advanced cruise appears to be in the prototype phase. In his 3 June 1986 speech to the Congress, President Reagan commented: "We are in the stages of final development of — and soon will begin to deploy — the Advanced Cruise Missile." If so, it is quite likely that the US would want to test the missile against both DEW and NWS radars, in which case it seems plausible that Canada might be asked to cooperate in the tests in much the same way as it has with the ALCM. See in particular Norman Friedman, "Stealth Technology, SDI and the Cruise Missile", *Military Technology*, October 1985, pp. 122-126.

Table 4

Soviet Bomber Forces in 1993 Under Three Arms Control Scenarios

Scenario	Systems Deployed	Total Bomber Weapons	Total Launchers	Total Warheads	% Bomber Weapons of Total Strategic Weapons	% Bombers of Total Strategic Launchers
Current Forces	40 Bear H with 8 ALCM 100 Bear B/C/G with 4 nuclear charges 20 Bison with 2 nuclear charges (160)	760	2,381	10,339	7.6	6
A. SALT II Extended	80 Bear H with 8 ALCM 40 Blackjack with 12 ALCM 52 Blackjack with bombs (172)	1,536	2,510	13,268	6.9	11.6
B. COMPROMISE NST: 6,000 ballistic missile warheads and ALCMs with freedom to mix. A maximum of 350 bombers. No direct limit on SRAMS and bombs as implied in Reykjavik	110 Bear H with 8 ALCM 50 Blackjack with 12 ALCM 25 Blackjack with 8 bombs 40 Bear H with 8 bombs (225)	2,000	1,600	9,520	30	14
C. No Arms Control. Modest Growth. No BMD	150 Bear H with 8 ALCM 100 Blackjack with 12 ALCM (250)	2,400	3,232	17,862	7.7	13.4

Note: 1. Backfire excluded

Sources: 1. Arms Control Association *Countdown to SALT*
2. John W.R. Taylor, "Gallery of Soviet Aerospace Weapons" *Air Force Magazine*, March 1986
3. Unpublished information supplied by Edward L. Warner III, Rand Corporation

Second, the greater the emphasis placed on SDI, the more likely it is that the Soviet Union will expand its strategic cruise missile programme as a hedge against the potential defeat of the ICBM. Although this development is, or was, constrained by SALT II insofar as bombers are concerned, the lack of constraints on surface ship- and submarine-launched cruise missiles clearly opens the way for major force developments in this area.

Submarine/SLCM Trends

Table 5 illustrates the current ranges and accuracies of submarine-launched ballistic missiles on ice-capable Soviet ballistic missile submarines (SSBNs). The following observations provide a brief summary of the conclusions which may be drawn from the detailed literature on Soviet submarine programmes.

The Soviet preference for land-based ICBM forces reflects several factors, including the geopolitically disadvantageous position of the Soviet Union in terms of ocean access; limitations hitherto in submarine and SLBM technology involving range, noise, accuracy, and reliability; and Soviet strategic doctrine which, in the event of a nuclear exchange, calls for damage limiting counter-force strikes against US strategic targets, thereby making the ICBM a far more attractive weapon system than a sea-based system because of its greater accuracy and ease of command and control.

These factors indicate that the ballistic missile submarine has served primarily as a second strike, reserve capability. This has been reflected in the retention of most Soviet SSBNs in sanctuaries near their home ports, and in the relatively small portion of boats kept at sea (around 15 per cent, compared to up to 60 percent for the United States).

Since the late 1960s, the Soviet Union has stationed a small number of Yankee-class SSBNs off the East and West coasts of North America, and it has recently augmented these with more modern Delta-class boats. It is assumed that the purpose of such deployments, which may amount to three or four boats on patrol at any given time, is to reduce warning time to "soft" military targets such as SAC bases and centres of military and political control. Table 5 also calculates the single-shot kill probabilities (SSKP) of Soviet SLBMs, which clearly indicates that they do not yet have counter-silo capabilities. For comparison, the SSKP of the Trident D-5 is added. On the one hand, the qualitative superiority of the D-5 is evident; on the other, the likelihood is that Soviet SLBM accuracies will continue to improve to the point where the counterforce capabilities of Soviet submarines will become a factor in US strategic planning. Furthermore, if the accuracy and reliability of Soviet SLBMs increases, this would expand the target set available to these systems, thereby increasing the utility of forward basing for "precursor" or counter-force missions. While this may not imply 'peace time' forward stationing, it may well suggest the probing

Table 5

Soviet Submarine-launched Ballistic Missiles/Ice-capable Submarines

Submarine	Power	Number	Missiles	Missile Range	Missile/ submarine	Warheads/ Missile	(Mt) Yield	CEP (n.mi.)	SSKP (2000 psi)
Typhoon	Nuclear	4	SS-N-20	8,000	20	9	0.10	0.26	9%
Delta IV	Nuclear	2	SS-N-23	8,300	16	7	0.35	0.50	6%
Delta III	Nuclear	14	SS-N-18	6,500	16	7	0.20	0.32	8%
Delta II	Nuclear	4	SS-N-8	7,800	16	1	0.80	0.48	10%
Delta I	Nuclear	18	SS-N-8	7,800	12	1	0.80	0.48	10%
Yankee II	Nuclear	1	SS-N-17	3,900	12	1	1.00	0.80	4%
Yankee I	Nuclear	19	SS-N-6	3,000	16	1	1.00	0.70	6%
		62						Trident D-5	98%

CEP = 0.06
Y = 0.475 mt.
H = 2000 psi

Sources: for all data except SSKPS
IISS *The Military Balance 1985-86*
SIPRI *World Armaments and Disarmament* 1986
John Collins and P. Cronin, *US/Soviet Military Balance* CRS Report No. 85-83F
Barton Wright *Soviet Missiles* World Weapon Database vol. 1

Notes

1. The yields of the SS-N-20 and SS-N-23, according to some sources, might be as high as 0.50 kt.
2. Estimates of CEPs vary considerably. The figures used here are primarily from IISS which tend to assume higher accuracies than other sources.
3. SSKP is "the probability that a single *reliable* warhead can be expected to destroy a given target."

The equation for SSKPs is: $SSKP = 1\text{-}0.5^{\frac{(8.41Y^{2/3})}{H^2 (CEP)^2}}$ where CEP = circular error probable,
Y = yield
H = hardness

of the Canadian Arctic basin for navigational experience and knowledge of open water areas.

Notwithstanding these future possibilities, there is no indication that the deployment patterns of Soviet SSBNs will alter substantially in the near-term. The increased range of Soviet SLBMs reduces the requirement for forward-basing, and suggests a continued Soviet interest in basing SSBN forces close to home in protected sanctuaries. In regard to the Arctic, the Delta and Typhoon class SSBNs are the most ice-capable, and thought likely to patrol either in the deep Polar basin, or in the marginal ice zone where acoustic detection is made difficult by environmental noise. In sum, although it is clearly possible for Soviet SSBNs to operate in the Canadian Arctic, there is no obvious advantage to this — particularly given the range of the SS-N-18, -20 and -23 ballistic missiles as indicated in Table 5 — unless surveillance of the area were so neglected as to invite exploitation.

If Soviet deployment patterns were to change, it is likely that this would be as a result of current US naval strategy aimed at placing pressure on Soviet SSBNs in the Norwegian Sea. In response, and with greater confidence in the ability of the modern SSBNs to avoid detection, the Soviet Union may seek to deploy a larger portion of its forces over a greater area. Improved submarine ranges and low noise characteristics may permit this. Although the most modern Soviet submarines still fall short of their US counterparts in their ability to avoid detection, it is clear that the Soviets have made major improvements in the quieting of nuclear submarines. The new Akula class SSNs, for example, are reputed to be able to pass through the SOSUS chain without detection.[12] Other US sources speak of a rapidly narrowing gap in the noise levels of modern Soviet submarines compared with the US, and perhaps indicatively, the US Defence Advanced Research Projects Agency (DARPA) has initiated a series of studies on non-acoustic methods of detection.[13]

Finally, the increasing vulnerability of Soviet *land-based* missiles may increase Soviet reliance on sea-based forces, and further encourage the more extensive use of ocean areas, including the Arctic.

Table 6 indicates the variety of SLCMs carried by Soviet submarines.

Several general observations may be made about the Soviet SLCM inventory. First, until the deployment of the SS-N-21, Soviet SLCMs did not have the range to attack US military targets from Canadian Arctic waters, but the SS-N-12 and SS-N-19 have permitted such targeting from Canadian waters on both the Atlantic and Pacific coasts.

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[12] SOSUS (Sound Surveillance Underscan) is a passive sonar system. Although the exact locations are secret, it is generally known to be located between Greenland and Scotland, in the Norwegian Sea, the straits of Gibraltar and the Pacific so that all Soviet submarines can be detected as they leave their home ports.

[13] *Defence Week*, Monday, 24 November 1986.

Table 6

Soviet Submarine-launched Cruise Missiles

Missile	First Year Deployed	Launchers	Range (km)	Yield (Kt)	Carrier	Power
SS-N-3	1962	244-264	450	350	Echo II	Nuclear
SS-N-7	1968	80-96	45-55	200	Charlie I & II	Nuclear
SS-N-9	1968/69	218-224	280	200	Charlie II	Nuclear
SS-N-12	1976	120	500-1,000	350	Echo II	Nuclear
SS-N-19	1980	88-112	460-500	500	Oscar	Nuclear
SS-N-21	1986?	?	3,000	200	Victor	Nuclear
		750-816				

Sources: W. Arkin and J. Sands. *The Soviet Nuclear Stockpile* May 1985
J. Collins and P. Cronin *US/Soviet Military Balance* CRS Report No-83F, January 1985
IISS *The Military Balance* 1986-1987.
Barton Wright, *Soviet Missiles* World Weapon Database, vol. 1

Notes

1. A new, long-range SLCM, the SS-NX-24 was expected to be operational in 1986 (CIA National Intelligence Estimate NIE-II-E-885), although this now seems premature. It is currently deployed on a converted Yankee submarine test platform.
2. Approximately 85% of SLCMs have a range below 600 km, and would not, therefore, have been banned under the original Soviet proposal of 30 September 1985.
3. Some sources credit the SS-N-21 with a c.e.p. of 150 feet. For comparison, DoD spokesmen have claimed a c.e.p. of 25 ft. for the sea-launched Tomahawk.

Second, there is an asymmetry in the Soviet and US programmes. The US programme has emphasized surface-ship deployments while the Soviets have emphasized submarine deployments. Combined with the disparities in range, this difference has important implications for arms control. For example, in October 1985 the Soviet Union proposed to ban all cruise missiles with a range in excess of 600 kilometres, which would have allowed approximately 85 per cent of the Soviet SLCM force to remain, while virtually eliminating the US Tomahawk programme. More seriously, perhaps, in the light of the potential for a sharp increase in long-range SLCMs, a more recent Soviet proposal suggested verifiable ceilings on submarine-launched SLCMs and a ban on ship-launched SLCMs. Though plausible given the difficulties of verification (presumably a counting rule can be devised for submarines but not for surface ships), this approach is also asymmetrical in that it discriminates against US surface strength in SLCM deployment while leaving the Soviet submarine capability largely intact. It follows from this that, in the near term, even on technical grounds alone, there is little chance of superpower arms control agreements which will forestall possible SLCM deployments in the Arctic.

US sources indicate that the Soviets are about to deploy the long-range SS-N-21, the reported characteristics of which suggest that it is from the same engineering family as the AS-15.[14] If so, the range may be 3000 kilometres, implying that, like the AS-15, it could be fired from within the Canadian Arctic archipelago and reach military targets in the northern United States. Although the land-attack capability of the SS-N-21 is likely to be limited for several years, it must be assumed that the accuracies of the US Tomahawk SLCM will eventually be matched, giving it a clear counter-force capability against fixed targets. The SS-N-21 fits the standard Soviet 53-cm torpedo tube, and can be retrofitted into all classes of Soviet submarines. The implication is that the various classes of Soviet SSNs might carry a torpedo/SLCM weapon mix, thus taking advantage of the larger numbers of Soviet hulls (the Soviet Union has 200 SSNs compared with 97 deployed by the United States).

Finally, the Soviet Union is developing a larger cruise missile (the SS-NX-24) which does not fit the standard torpedo tube but is being tested on a converted Yankee SSN and may require a new submarine platform.[15] While longer range may be of value for a number of theatre deployments, the presumed longer range of the SS-NX-24 is particularly important in the context of the Arctic. If the SS-NX-24 could be launched

[14] For a discussion of the significance of the SS-N-21 in the future development of Soviet naval strategy, see Anthony R. Wells, "The North Atlantic and Arctic Theaters of Operations", in ed J.L. George, *The Soviet and Other Communist Navies: the View from the Mid-1980s*, (the US Naval Institute Press, Washington, D.C., 1986).

[15] US spokesmen stress the greater versatility of the Tomahawk, partly because it is fired vertically from submarines. Insofar as the Soviet submarines fire SLCMs through the torpedo tubes, they may have much greater difficulty in ice conditions because of the need for an initial horizontal run by the SLCM. The SS-NX-24 is said to be fired at a different angle from the *Yankee* testbed, which may imply that an entirely new platform and firing angle is under development, possibly more effective in Arctic conditions.

from beyond the Canadian Arctic islands and reach military targets in the United States, there would be a need for detection and tracking capabilities much superior to those currently promised in the North Warning System.

Despite these prospective developments in Soviet SLCM programmes, it remains unlikely that SSBNs and SSNs carrying cruise missiles would make use of restricted Canadian Arctic waters on a regular basis. In sum, the position appear to be as follows:

1. Given the ranges of the most modern Soviet SLBMs, and the relative protection of home waters, the Soviet marginal ice zone, and the deep Polar basin, the strategic reserve function of Soviet SSBNs is better served from the Soviet rather than the Canadian side of the Arctic.

2. The future use of the Canadian Arctic for deployments of submarines in a precursor or decapitation role cannot be ruled out, but the distances involved suggest that, for most targets, Pacific and Atlantic deployment would be far more advantageous. This, of course, raises the possibility of greater Soviet use of non-Arctic Canadian coastal waters in proximity to US military targets.

3. On the other hand, it is evident that Canadian Arctic waters are useful to US attack submarines seeking to enter Soviet submarine sanctuaries in the Norwegian and Greenland seas via the Polar basin. For example, the Sturgeon class SSNs, some of the Los Angeles 688 class, and the planned new US attack submarine, the SSN-21 Seawolf, have an under-ice capability. Soviet activity in the Canadian Arctic might be motivated in part from the need to counter this anticipated US threat, in which case it could be expected that the Soviets would apply pressure on the choke points — the navigable channels from the waters of the Canadian archipelago into the Arctic basin. In addition, if the Soviet Union anticipates US forward pressure on Soviet SSBN sanctuaries, the use of Canadian Arctic basin waters as an unexpected dispersal area in times of crisis cannot be ruled out.

4. Finally, Soviet SSNs might use Canadian Arctic waters to avoid the more heavily defended G-I-UK gap in order to deploy into the North Atlantic. Although this is superficially plausible, it should be remembered that there are major offsetting disadvantages to transit through Canadian Arctic waters. First, Arctic under-ice navigation is far more difficult and dangerous than traditional open-ocean routes. Second, as discussed in section VI, it would be relatively easy to close off the Canadian Arctic straits with modest under-sea detection systems augmented in times of crisis by anti-submarine warfare (ASW) forces.

If these general propositions are correct, an analysis of Canadian naval requirements in the Arctic might focus on two propositions. First, there is a strong case for the development of a Canadian ASW capability within the waters of the Archipelago, the purposes of which would be to provide

peacetime surveillance, to close the waters in time of crisis, and generally, to deter potential intruders who might otherwise seek to exploit Canadian Arctic waters. Second, given scarce resources, there is a lesser case for developing an ASW capability in the Arctic basin. This is less convincing both because the size of the basin makes the task more difficult, and because an active ASW capability would at that point be inextricably caught up in the US naval strategy of carrying ASW to the Soviet SSBN sanctuaries. This policy, which has been the source of a protracted debate during the Carter and Reagan Administrations, calls for the insertion of US nuclear submarines in the Barents Sea, and envisages the use of conventional weapons against Soviet sea-based retaliatory nuclear forces in order to deter the Soviets from initiating or continuing a conventional war in Europe.[16]

[16] See John J. Mearsheimer, "A Strategic Misstep: The Maritime Strategy and Deterrence in Europe", and Linton F. Brooks, "Naval Power and National Security: The Case for the Maritime Strategy", in *International Security*, Fall 1986, pp. 3-89.

IV.

THE NEAR-TERM IMPACT OF THE STRATEGIC DEFENCE INITIATIVE (SDI)

The primary focus of this section is not the SDI, but the possible implications of the SDI programme for Canadian-US co-operation in continental defence. It is worth noting that initial US plans called for a decision in the early 1990s to move from research in the SDI programme to development and deployment. More recently, however, doubts have been expressed about this timing, suggesting slippage to the mid 1990s.[17] Despite the protracted Canadian Parliamentary enquiry into SDI at the time of the recent NORAD renewal, it is possible that the next renewal of NORAD (in 1991) will also take place in an uncertain SDI environment.

In searching for the impact of SDI programmes on Canadian-US defence relations, therefore, the central reality is the uncertainty that surrounds both the programme elements and the timing of a development decision on ballistic missile defence. On the one hand, it is not difficult to note that if the surveillance systems associated with SDI are ever deployed, surveillance and defence against the manned bomber will be fundamentally changed. Space-based radars, for example, will probably be dual capable, able to scan for both missiles in space and aircraft close to the earth. Ground-based lasers and other weapons may be capable against both ballistic and air-breathing missiles. At that point, SDI and air defence would become merged both conceptually and operationally.

On the other hand, while it is tempting to contemplate a variety of systems which may result from the SDI research programme, the central reality is that no systems design has *yet* emerged from the programme. In particular, most observers now accept that a fully-developed population defence against missile attack cannot be deployed or even perhaps designed in the next twenty years.

In the near term, there are a number of factors which add to the uncertainty of the programme:

(i) ***Congress and Defence Budgets:*** cost considerations, together with Congressional budgetary actions, may impede or even halt currently planned SDI programmes.

(ii) ***Technological Progress:*** unanticipated technological success or persistent failure may accelerate or retard the SDI programme, possibly

[17] *The Report to the Congress on the Strategic Defense Initiative* (June 1986) uses the following guarded language on the matter of timing: "In our role of defining feasibility and cost, we have structured our efforts to support an early 1990s decision on whether to proceed with confidence along a development path. In other words, the majority of effort needed from that point on should be engineering in nature rather than experimental." (pp. 11-13)

leading to decisions to pursue less ambitious BMD programmes such as limited defences of ICBM silos and other military assets.

(iii) ***Alliance Reactions:*** a decision to accelerate or postpone an SDI deployment decision will be affected by allied policies and reactions, including their interest in a defence against tactical ballistic missiles.

(iv) ***The Next US Administration:*** on the assumption that a decision will not be taken before 1989, the future of SDI will be dependent on the strategic and arms control policies of the next US Administration, or even the one after that.

(v) ***Arms Control:*** the success or failure of the ongoing Geneva Negotiations may yet have a major impact on the future of SDI, leading either to its *de facto* demise or acceleration. So too will the fate of the Anti-Ballistic Missile (ABM) Treaty.

In sum, technological uncertainty makes it difficult to speculate about the long-term prospects, while political factors cloud the near term. It is nevertheless possible to identify certain plausible developments in the near or middle term which could have a significant impact on the bilateral defence relationship.

First, within the terms of the ABM Treaty, the United States might choose to exercise its option to deploy an ABM system at one location. The purpose of this would be the defence of one American missile field. The difficulty may be that the presently designated location (Grand Forks) might not extend defensive coverage to the present basing mode of the MX missiles, (Wyoming), but an agreement to relocate the American site could hardly be considered an erosion of the Treaty.

Such a point defence could be deployed within the next few years using existing technologies. For example, both exo-atmospheric (HEDI) and endo-atmospheric (ERIS) interceptors are being tested within the terms of the ABM Treaty. Both are single-warhead interceptors without the capacity for rapid reload, meaning that both could be deployed within the terms of Article V of the ABM Treaty.[18] Although it may be farfetched,

[18] See *Report to the Congress on the Strategic Defense Initiative*, June 1986, pp. C-14, C-15: "The High Endoatmospheric Defense Interceptor (HEDI) project is to demonstrate the capability to intercept and negate strategic ballistic missile warheads within the atmosphere using a non-nuclear interceptor missile. Flight tests will be performed at White Sands Missile Range (WSMR) and Kwajalein Missile Range (KMR). All flight tests will be from fixed ground-based launchers without the capability of being rapidly reloaded or launching more than one interceptor missile. The interceptor missiles will not be capable of delivering more than one independently-guided warhead. All activity will be conducted in a manner permitted by the ABM Treaty. The Exoatmospheric Reentry-Vehicle (RV) Interceptor Subsystem (ERIS) is intended to engage incoming RVs prior to entry into the atmosphere. This is an allowed test of a non-nuclear interceptor missile. All interceptor missile flight tests are to be conducted from fixed ground-based launchers at KMR. The planned flight tests include launch of the first stage, launch of all stages without homing, homing against a point in space, and hit-to-kill against targets. Fixed ground-based

particularly in cost terms, to deploy only one system, the pressure from proponents of SDI to initiate early deployments, and the prospect that a treaty-compliant deployment might be more acceptable politically, while not precluding a subsequent break-out from the Treaty, suggest that point defence using 'non-exotic' technologies might be the most realistic option for the Reagan Administration.

In this event, and using non-nuclear warheads, it is not evident that the interception zone itself would create any major issues concerning Canadian territory. However, such a point defence would then focus attention on defence against the air breathing threat. It is possible that the first stages of a new air defence might in turn be a *point* defence of ICBM and ABM bases rather than an area defence, implying that there would not necessarily be any greater pressure to increase capabilities in the far North. But if a point air defence of an ABM site required the interception and destruction of Soviet cruise missiles, possibly by that time with supersonic dash, detection and tracking might be much more likely to involve Canadian air space close to the defended sites.

On the latter point, the debate about the deployment of the Sprint/Spartan system in the 1960s may still be relevant as an indication of the air defence implications of a point defence ABM system. More broadly, the possibility that the United States might deploy an ABM system in this way should act as a caution in formulating Canadian policy on the ABM Treaty. Presumably, there could be no formal objection to a US deployment which was initially within the terms of the ABM Treaty or required only minor renegotiation. At that point, within the framework of the NORAD Agreement there might be considerable pressure to participate with the United States in surveillance systems associated with that deployment.

Second, to continue this consideration within the perspective of the next decade, it is also plausible that the United States might deploy a more extensive but still preferential defence. A preferential defence can take a number of forms: it may involve the defence of military assets widely dispersed, and/or the defence of certain industrial or urban areas. It is preferential because it is not predicated on the assumption that all military and other values can be defended, and it does not, therefore imply a full-scale, leakproof deployment. Achievement of a preferential defence may involve a variety of systems, but it could be confined to the ground-based terminal defence systems which seem likely to yield feasible development programmes before the space-based systems. (A view which is

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[18] (Cont'd)
launchers will be incapable of launching more than one interceptor missile and will not be rapidly reloadable. The ERIS interceptor missile will not be capable of delivering more than one independently-guided warhead." ERIS might usefully be based further north to allow the possibility of multiple intercepts. However, the further north the basing, the more the intercept would involve solving the problems of mid-course tracking and discrimination.

strongly reinforced by increasing recognition of the difficulties associated with mid-course detection, tracking and interception).

So far, the issues raised do not constitute a compelling case for concluding that any specific programme would necessarily involve the use of Canadian territory. However, more speculative technologies, such as Braduskill, may require Northern deployment, in which case Canadian basing may be a prerequisite for an effective system.[19] Although there is considerable uncertainty, therefore, the combination of polar routes and 'layered' defence systems does in fact lead to the presumption that Canadian territory will become the strategic foreground for ABM defence, and that, sooner or later, Canadian participation would be required. This raises the prospect that if Canada were determined to abstain from involvement in ABM defences, the Government might declare specifically that it would not lend Canadian territory to ABM deployments. Leaving aside the obvious political issues arising from such a declaration, this might well influence the US research programme since such a declaration would adversely affect the prospects of those systems which were likely to benefit the most from Canadian deployment. It is nevertheless a complex and awkward option, since the Government could find itself refusing to co-operate in the deployment of ABM defences while actively supporting a concomitant increase in defence against bombers and cruise missiles which was itself the consequence of ABM deployments.

In any event, greater activity in the air defence field will not necessarily await a positive decision concerning SDI. As was noted earlier, such activity has proceeded independently of the SDI programme. It may, however, be implicitly linked to a pro-SDI strategy for the following reasons:

(i) a desire to spread defensive system expenditures over as long a period as possible, and thus to begin with the known technologies of air defence;

(ii) a desire to counter criticism of SDI by demonstrating that defensive systems are feasible, and that there is a defence against the cruise missile, and

(iii) a desire to develop surveillance systems for air-breathing systems which may have eventual utility for detection and threat assessment in a BMD role. Both space-based radar and satellite infra-red imaging experiments such as Teal Ruby might be examples of this interdependence between SDI and air defence.

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[19] Braduskill is "a next-generation exo-atmospheric interceptor that is intended to meet the growing Soviet threat of decoys by being able to distinguish between a decoy and an actual warhead". It is not immediately apparent why Braduskill, if developed, would require deployment in Canada rather than Alaska. However, Braduskill programme analysts are reported to have said that Canadian deployment is essential. Braduskill would be fired from the far north toward the United States, flying alongside incoming re-entry vehicles for 10 to 15 minutes while it discriminated between decoys and warheads. *Inside the Pentagon*, 14 March 1986, 4 April 1986.

SDA and ADI: The Strategic Defense Architecture 2000 and the Air Defence Initiative

Any doubts about the future interdependence of air and space defence are removed by consideration of the research and development objectives of the Air Defence Initiative (ADI), which itself appears to have emerged from the efforts to design a complete strategic defence system in SDA 2000.

It will be recalled that the North American Air Defence Master Plan, submitted to Congress in March 1982 and the basis of continental air defence policy since, proposed, *inter alia*, East and West coast Over-the Horizon Backscatter (OTHB) radars, and the modernization of the DEW line. At the time, the US Air Force explicitly rejected both space-based radars and airborne surveillance systems on the grounds of cost, and also because the development period was considered too long to meet the immediate need for improved surveillance.[20]

In December 1982 — sometime, it should be noted, before President Reagan's SDI speech and without any indication that it was an intentional precursor of this — Phase I of SDA 2000 was initiated. It was designed to project the air-breathing threat to the year 2000, and to suggest an air defence design to counter it. SDA 2000 Phase II commenced in 1984 — given President Reagan's speech, it was now clearly linked to the SDI programme — and was intended to integrate air and space defence concepts, including an assessment of the multi-mission applications of what might otherwise be thought of as SDI projects. Phase II is directed towards future air defence technologies, the application of which would, presumably, be largely or even entirely dependent on decisions concerning SDI.[21]

The ADI is a Research, Development, Testing and Evaluation Programme (RDT&E) addressing some of the issues emerging from Phase I of SDA 2000. Announced by the USAF in April 1986, the purpose of ADI is to develop technologies appropriate to surveillance, interception and battle management in regard to hostile bombers and cruise missiles. Funding for all three research programmes is now in the 1987 US defence budget, and requests for proposals have been issued by USAF research centres.[22]

In the surveillance programme, major emphasis will be placed on the survivability of surveillance systems through all phases of a nuclear attack.

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[20] For comments on the NWS as an interim measure, see the testimony of General Kautnya to the House Armed Services Committee, H.A.S.C. 99-2 (1985), part. 2 p. 980; see also the discussion below of space-based radars, pp. 38-41.

[21] For an overview of SDA 2000 in relation to SDI, see US Senate Committee on Armed Services, Hearing 99-58, pt. 7, pp. 4266-4267.

[22] US Department of Defense FY 1987 RDT&E Descriptive Summaries, Programme Elements numbers 63368 F, 63369 F and 63716F.

One of the first programmes, for example, is a design for an airborne radar technology for detection and tracking of all airbreathing threats. The programme assumes that, in addition to an enhanced capability against current generation cruise missiles, future surveillance technologies must be effective against stealth technology. The intent is clearly to explore a variety of possibilities, including remotely piloted aircraft, airships, and, at the other end of the range, ground-based vehicles using existing UHF television towers. Considerable emphasis will be placed on the proliferation of low-cost sensors as the solution to the problem of survivability.

In the effort to intercept and destroy the cruise missile, emphasis is placed on both conventional manned interceptors with improved look-down/shoot-down capabilities, and on the development of ground-based long- and short-range interceptor missiles. Clearly, the short-range interceptors are compatible with the point defence of US strategic forces alluded to earlier as a possibility compatible with an ABM point defence. The long-range interceptor missiles inevitably point to forward basing in Canada since it must be assumed that a layered air defence would seek several opportunities to defeat the hostile bomber, beginning with the attack on the bomber itself, and continuing through the various phases of cruise missile flight. For example, the Defence Advanced Research Projects Agency (DARPA), in ADI-related work, is examining the feasibility of an interceptor missile with a range of 2000 miles and a speed of 7000 m.p.h., thus making Polar intercepts a forseeable prospect. And finally, research in battle management will seek to link existing command and control systems with those required to control multiple platforms against multiple targets, once again emphasizing the survivability of command and control through all phases of a nuclear exchange.

The Air Defence Initiative is intended to permit demonstrations from late 1987 through 1988, with the determination of final systems architecture in 1990. Quite clearly, further steps would be closely related to decisions concerning SDI, but it is nevertheless possible that, by 1990, and long before the conclusion of the SDI research programme, technology demonstrations will have occurred that may make feasible dramatic changes in air defence. Despite the possibilities of technological leaps, however, in one sense, the prospect is a familiar one. All such systems imply the northward extension of the combat zone, and reaffirm the position of the Canadian North as the strategic foreground for the air defence of the continental United States.[23]

[23] For example, the chief ADI planner has commented: "The focus of ADI is trying to engage the weapons carrier as far out as possible. . . . It's very similar to engaging ICBMs in the boost phase", *Military Space*, 13 October 1986. On the connection to SDI, see the comments of Francis P. Hoeber, a member of the DoD General Advisory Committee on Arms Control and Disarmament, who has noted that "the technologies of air and missile defence are converging at the margin as high tech air defences become somewhat capable against missiles", *SDI Monitor*, 8 September 1986.

V.

CURRENT AND NEAR-TERM SURVEILLANCE SYSTEMS

General Observations

Historically, the Canadian contribution to surveillance systems has been portrayed as both responding to the needs of assured deterrence and contributing to the maintenance of Canadian sovereignty. Although, as indicated earlier, the link between 'deterrence' and 'war-fighting' has always been stronger than Canadians preferred to contemplate, a number of current trends seem likely to make this traditional distinction less and less persuasive.

First, it is well understood that progressive Soviet developments in ICBM and SLBM capabilities have shortened warning times and raised doubts about the survivability of key elements in the US retaliatory forces, thus increasing the importance of surveillance, early warning and threat assessment. Paradoxically, this has been accompanied, at least temporarily, by a decrease in the need for Canadian territory and, perhaps, Canadian co-operation in surveillance systems.

Table 7 seeks to demonstrate at an elementary level the small contribution that Canada now makes to continental surveillance systems reporting to NORAD.

In summary, as US surveillance assets have increased through such major developments as the Navy Space Surveillance system (NAVSPASUR), the Air Force Space Track System, and particular programmes such as BMEWS modernization, Canadian assets have become less relevant. The operation of the Pinetree line, for example, is no longer supported by the United States, and will be progressively phased out. The Baker-Nunn Camera System will also be phased out soon, and the OTH-B radars on the East and West Coasts will be entirely US owned even though there will be limited Canadian participation in the manning of them. The North Warning System (NWS), which is itself an interim response to the evolving nature of airborne threats, soon will be the only tangible Canadian contribution to the surveillance assets reporting to NORAD.

Second, as illustrated in the ADI, surveillance systems are likely to change in the foreseeable future. Within the time frame of the ADI tests, therefore, Canada may need to face decisions about how much it wants to be involved in the new US technologies of surveillance to ensure an adequate flow of information concerning Canadian territory.

Third, *independent* Canadian decisions about follow-on systems designed to ensure adequate *national* surveillance of Canadian territory may be extraordinarily difficult without full knowledge of US programmes. Since major procurement decisions by Canada (for example, NWS, or AWACS) may be quickly overtaken by new developments in US research

Table 7

Surveillance Assets and Ownership

US Space Command – Pave Paws
– BMEWS
– GEODSS

Tactical Air Command
– Interceptors
– Joint Surveillance System (JSS)
– Icelandic Sensors
– DEW Line/North Warning System
– OTH-B

Air Force Spacetrack System

– BMEWS
– Pave Paws
– Cobra Dane
– other contributing radars
– Satellite Early Warning System
– Pacific Barrier Radar
– Baker-Nunn System
(including a site at St. Margarets, New Brunswick)

Naval Space Surveillance System (NAVSPASUR)

– 3 transmitting stations, 6 receiving stations

data from – NAVSPASUR
– AF — Spacetrack
– Canadian Operated Sensors
|
Space Surveillance Centre — NORAD

and development, there will be a continuing need to stay involved in surveillance technologies no matter how great the commitment to existing programmes.

Finally, the thrust of the ADI programme emphasises once again that US operational doctrines have evolved in directions emphasizing limited nuclear options and nuclear war-fighting, all of which require robust surveillance and threat assessment assets and reflect the continuing erosion of the distinction between "deterrence" and "defence". As consideration of the NWS reveals, the future US response to bilateral co-operation may also be unpredictable. In general, it is reasonable to assume that even if the US need for joint arrangements with Canada declines, Washington will, as a matter of policy, want to continue to involve Canada in continental defence. However, Canadian *access* to surveillance data, which has been considered to be a primary benefit of the NORAD relationship, may continue to decrease as it has in recent years.

Table 8

Unified Space Command

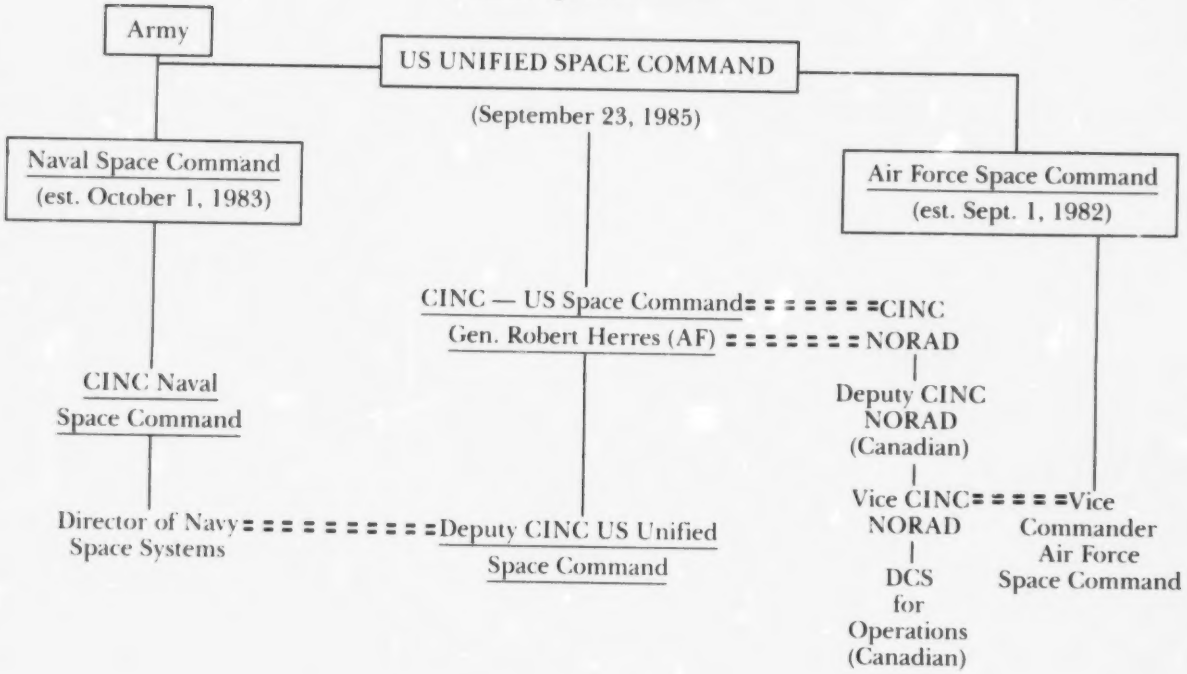

Table 8 read in conjunction with Table 7 seeks to illustrate this general observation with reference to Space Command. In sum, "NORAD" as it is now understood by Canadians is a very small adjunct to Space Command. All NORAD generated information will feed into Space Command; how much non-NORAD generated information will feed back to Canadian authorities is a moot point. In this respect, there is, of course, an oddity in the creation of Unified Space Command. The United States has subsumed NORAD — a command created by international agreement, though admittedly not by treaty — under a unified national command system. Although somewhat obscured by the fact that the Commander-in-Chief of NORAD (CINCNORAD) became Commander-in-Chief of Unified Space Command, the logic of the organization chart is that the NORAD commander reports to Unified Space Command and to the Canadian Government. The reorganization involved in creating Unified Space Command was more palatable to Canada precisely because General Herres wore 'three hats', but there is no logical requirement for this to be so, and in the future it is not inconceivable that CINCNORAD or his Canadian deputy will report to a CINC Unified Space Command who is not only a different but also a more senior officer.[24] Clearly, there are anomalies in this arrangement which can only be explained by assuming that the Canadian deputy CINCNORAD will have access to some but not all data available to CINC Unified Space Command.

As can be seen from Table 7, however, the organizational change only reflects the basic realities of resources applied to continental defence. Although the question of how much information is shared cannot be answered clearly, it is obviously affected by the following factors:

(i) ownership, where it may be assumed that sole US ownership will predispose stricter controls on sharing;

(ii) location, where it may be assumed that if assets are deployed on Canadian territory there is a greater likelihood of shared information;

(iii) operation, where it may be assumed that non-NORAD operated assets will also restrict information exchange, and

(iv) sensitivity, in that information may be considered too sensitive to pass on to Canadians. For example, information that gave access to US and Soviet strategic plans would doubtless transcend any perceived Canadian "need-to-know", and communication which revealed the location and operational practices of SSBNs and SSNs might also be considered beyond the authority of NORAD.

[24] At the beginning of October 1986 General Herres relinquished his position as CINC Air Force Space Command "to concentrate entirely on his 'warfighting' jobs as CINCSPACE and CINCNORAD". (*Military Space*, 29 September 1986.) For an explanation of the relationship between the various commands, see Herres' testimony in *Minutes, Standing Committee on External Affairs and National Defence*, Issue number 54, 11 December 1985.

Three Surveillance Systems

A. ***The North Warning System***

The North Warning System was designed for the following reasons:

- to provide an improved capability as compared to the DEW line against aircraft penetrating North American airspace across polar routes, and to eliminate gaps in radar coverage;
- to permit the engagement of cruise missile carrying bombers before they release their missiles, and to provide an ability to detect and track the cruise missile itself; and
- from the Canadian point of view, to provide general surveillance of the approaches to Northern Canada, and to ensure a co-operative approach such that the Canadian requirement for national surveillance is compatible with the US need for warning against bomber attack

In this list of objectives, US and Canadian interests overlap to some extent but not completely. For the United States, the NWS is an interim solution. Recognizing the limitations of continental surveillance at the end of the 1970s, and aware of the increasing potential of the cruise missile, the USAF was unwilling to wait for the superior technologies promised by airborne and space-based radar (SBR), the cost effectiveness of which were in any case uncertain. In response to Congressional enquiry, USAF spokesmen have made it clear that these new systems were considered too expensive, too problematic, and too distant to be a response to the practical needs of NORAD in the 1980s and early 1990s. It was said, for example, that a ground-based demonstration of SBR could not be provided before 1992. By contrast, and partly because of the savings achieved in the reduced requirements for manning, the NWS was considered an inexpensive interim solution, particularly when shared with the Canadians.

It is presumably because it anticipates these future developments that the United States is prepared to overlook the deficiencies of the system. First, although the NWS may be able to detect cruise missiles, its tracking capabilities are limited. At its maximum range of approximately 200 miles, the NWS can identify an aircraft at approximately 12,000 feet, while at 10,000 feet the aircraft could approach to within 120 miles of the system prior to detection. Moreover, low flying aircraft will pass through the radar envelope in such a short time that the opportunity to vector fighter aircraft to the point of interception will be very limited indeed. Once through the NWS, there is only sporadic ground-based capability to identify and track non-responding aircraft until they approach the present Pinetree Line, which itself is scheduled to be dismantled. Second, assuming a range of 3,000 kms, certain strategic military targets in the northern parts of the United States can be reached by AS-15 cruise missiles launched outside the envelope of the NWS, particularly from the direction of the Beaufort Sea, and they, of course, would be even more

difficult to track and intercept on the basis of NWS information. It follows that the difficulty of detecting the cruise missile would be even greater if it were submarine-launched, since in that case there could be little or no expectation that other surveillance systems would have detected the mother craft.

There are two obvious responses to this on the part of US planners. In times of crisis AWACS aircraft would be deployed to the north of NWS, and would take responsibility for surveillance and command and control to the south. Second, the NWS is not itself a survivable system. Excluding the distant prospect of a single, precursor surprise attack against selected US strategic forces which would take the chance of proceeding undetected through the NWS, the function of NWS would be served when it was destroyed immediately prior to the arrival of hostile bomber forces.

In sum, from the US point of view, NWS is a peacetime surveillance system designed to give reasonable assurance that a precursor or surprise attack is ruled out. Only when, or if, the United States moves to partial or full-scale defences will the threat of bomber attack become a war fighting problem, and at that point the technologies currently under investigation in the ADI will have replaced the NWS as the means to counter the air-breathing threat.

To the extent that NWS is a peacetime system, developed to ensure that the north of the continent is not left open in such a manner that US retaliatory forces are put at risk, Canadian interests are compatible with those of the United States. There are, however, two major points of divergence. The first concerns the Canadian interest in national surveillance of Canadian territory. The second raises the issue of Canadian acceptance and participation in nuclear war-fighting doctrines, and is addressed later in this paper.

While NWS undoubtedly provides improved coverage for military purposes in the North, in terms of general surveillance for sovereignty purposes it has serious deficiencies. Aircraft operating in or crossing the Canadian Arctic including commercial aircraft on scheduled flights and agreed flight paths, cannot be detected by the NWS radar envelope. As is clear from the above, there are also large areas between the present DEW and Pinetree lines in which there is no assured capability to monitor even civilian aircraft if they fail to respond at regular checkpoints.

Monitoring the Canadian interior (that is south of NWS) for general purposes of the assertion of sovereignty has so far evoked little interest in Canada. But knowledgeable Canadian commentators have argued that NWS is based too far south, and that, for purposes of national sovereignty, the line should either be relocated further north on the true periphery of the country — namely the Canadian Arctic islands — or that additional stations should be added on Melville and other Arctic islands.[25] If so, the

[25] See B. Gen. (Retd) C.E. Beattie and B. Gen. (Retd) K.R. Greenaway, "Offering Up Canada's North", *Northern Perspectives*, Vol. 14, Number 4, September 1986, pp. 5-8.

additional costs would presumably fall to Canada, since there is no obvious military advantage to the United States in this change. In current US planning, AWACS aircraft based in Alaska and Greenland would fly occasional patrols north of NWS (and therefore over the Canadian Arctic islands), with the expectation that in times of increasing crisis those forces would be progressively augmented. It is also proposed for symbolic reasons to allow Canadian military personnel to participate in such flights. There is little US advantage, therefore, in incurring the additional costs of relocating the NWS further to the north.

By contrast, the Canadian interest in relocation is not in providing greater protection to US retaliatory forces, but in ensuring adequate surveillance of its own territory and in preventing, *de facto*, a situation in which only the United States has such a capability. One must assume, therefore, that the motivating factors in the decision not to locate NWS further to the north were cost, as well as the relative lack of interest of the USAF in the military advantages of a more northerly deployment. More remotely, perhaps, US intelligence may simply have misjudged the ability of the Soviets to achieve the long range of the AS-15, in which case cost considerations would have been unchallenged. Curiously, despite the enormous public and Parliamentary attention focussed on the NWS decision in Canada, the actual operational merits of the proposal, which emerged from the Joint US-Canadian Defence Study (JUSCADS) in 1979, have received little attention. Specifically, the total cost ($1.29 billion) has not been broken down, and the detailed costs of deployment further north have never been explored in public discussion. Nor is it clear that the Canadian team pressed the enquiry in these terms, or that this was the preferred Canadian option.

B. *Airborne Warning and Control Systems (AWACS)*

In order to patrol both the interior of Canadian territory, which is currently not covered by national surveillance systems, and to allow adequate national coverage of the Canadian Arctic, the Canadian purchase of AWACS is occasionally cited as a technically and politically desirable solution. AWACS, however, is not a substitute for other systems; the combination of AWACS and a system less expensive but in continuous operation (either NWS or Space-based radar) may be attractive militarily, but raises familiar problems of capital procurement.

The essential difficulty with AWACS is the procurement and operating costs. The cost of the Boeing E-3A, for example, the most expensive but probably the most capable AWACS, including support costs, is in excess of $200 million per copy (In December 1986 the British Government announced a purchase of eight at a unit cost of US $160 million). The operating costs are claimed to approach $25,000 per hour. Since the radar radius of the E-3A is around 200 miles (although it is probable that cruise missiles could be tracked only at distances much less than that), it is estimated that minimal coverage of Canadian territory would require 4-5 aircraft. These costs can be reduced, allegedly by up to 50 per cent, by

obtaining cheaper versions which use platforms such as the Hercules or the Lockheed P-3 already in service with the Canadian forces. In this respect, however, it may be revealing that, although the Air Defence Master Plan called for the acquisition of 19 E-3A AWACS for the NORAD role, the US Congress has still not funded *dedicated* AWACS for continental defence, and the USAF appears content to draw on all purpose AWACS from Tactical Air Command as the occasion requires. To permit intermittent operations of E-3As in the continental defence order, however, it has equipped its NORAD regional operational control centres (ROCCs) with systems which would allow communications with northern deployed AWACS.

The Canadian choice, therefore, centres on the following issues. First, if USAF operations north of the NWS and over Canadian territory are considered unacceptable politically, or if the proposal to place Canadian personnel aboard is considered blatantly symbolic, then Canada might choose full partnership in northern-based AWACs and accept the cost implications. Second, Canada might choose to add NWS radars on the Arctic islands so that USAF routine AWACS surveillance flights took place only to the north of Canadian territory and over the Arctic Ocean, at which point they could be seen as an independent US initiative having no bearing on the Canadian need for national surveillance.

C. *Space-based Radar (SBR)*

Although the United States appears committed to the series of ADI technology developments that emphasize airborne and mobile ground-based survivable surveillance systems, its long-term objective continues to be the development of space-based radar and infra-red imaging systems. These systems would be of value both for fleet and air defence, but particularly for the latter. The cost trade-off, as USAF spokesmen have testified to Congress and elsewhere, is with known systems such as OTH-B and, even, the acquisition of increased interceptor capabilities. SBR, in short, will be justifiable as a combination of an improved detection capability and a force multiplier. Without identifying cost figures, it is apparent that large space-based radars capable of imaging objects as small as a cruise missile, and with an incremental capability to respond to stealth technologies, will be very expensive indeed. The Teal Ruby infra-red imaging experiment, which may or may not be able to identify very small objects, but which in any case cannot be seen as a single, stand-alone system because of the inherent limitations of infra-red, is now scheduled for launch in 1988. A ground-based demonstration of SBR is scheduled for 1992, and it would therefore be reasonable to assume that the very earliest time for a space launch would be in the mid-1990s. The number of satellites required for continuous surveillance is also unclear.

In Canada, proposals have been made to develop lower-powered SBRs, capable of imaging aircraft but not cruise missiles.[26] The advantage of a Canadian SBR of this kind would lie in its ability to monitor all aircraft operating in the Canadian Arctic, and possibly off the East and West coasts. It would offer greater survivability (though it would be eventually vulnerable to Soviet anti-satellite weapons (ASATs), greater coverage of the interior of Canadian territory, and economic and technological benefits to Canadian industry. The cost of a small system, assuming a minimum of four radar satellites and an equal number of military communication satellites, might be in the vicinity of $1.5 billion, or, as the leading proponent of the system has argued, $300 million per year until the system was in place, and a lesser sum thereafter for replacement satellites. The system here envisaged would be within the capabilities of Canadian industry, although, for the most part, it would rely on the launch facilities of the United States or, perhaps less likely, France.

It is, therefore, a case which must be taken very seriously. At the same time, the proponents of a Canadian SBR are faced with some serious questions. The first concerns the place of the ABM Treaty. Within the terms of the Treaty (Agreed Understanding F), phased array radars are permitted only at designated sites; elsewhere, they are permitted only if their power potential does not exceed 3-million square metre watts. Even if the SBRs contemplated were within that limit, a Canadian SBR might be seen as an indirect opportunity for the United States to evade the Treaty. It would be understandable, for example, if the Soviets suspected that a Canadian SBR within the terms of the Treaty was the precursor to a US radar which was not, a suspicion which would probably be more firmly entertained if there were considerable US co-operation in the Canadian development programme, as might well be the case. Moreover, it would be difficult to rule out the possibility of an add-on power potential which might give the United States an immediate capability in any future break out from the Treaty. Canada is not, of course, a signatory to the Treaty, but the Treaty itself contains a 'non-circumvention' clause (Article IX) which clearly imposes some political constraints on third parties who otherwise profess to be in favour of the Treaty regime.

Second, the national SBR proposal rests on unbuilt technology and unconfirmed costs. Generally, it is not clear that a country as small in population as Canada, and with a small military budget, can afford to take risks in development programmes. Both the efficacy and the cost of the programme would require detailed investigation if SBR were to become a serious contender. In that sense the opportunity may have passed with the decision of the Government to sign the NWS. Further consideration of a national SBR, therefore, might now be dependent on a US decision not to continue with the second phase of NWS, or on the emergence of political factors which give greater political impetus to national surveillance of the Arctic.

[26] See B. Gen. John J. Collins, OMM, CD, (Retd), "Military Use of Space by Canada in the Year 2000", in *Canadian Aeronautics and Space Journal*, Vol. 32, No. 3, September 1986, pp. 193-201.

Third, it seems probable that in the course of a Canadian deployment of an SBR with limited capability (although the same argument applies to NWS), the United States will opt to develop the systems now being explored in ADI, and also decide to proceed to a more powerful space-based system. At that point the NWS would become a redundant system, and a Canadian SBR at best a marginal contribution to bilateral efforts at continental surveillance.

In considering the merits of this proposal, therefore, it is clear that, essentially, the case for SBR depends primarily on the importance of national surveillance in the Arctic rather than on the maintenance of a shared air defence with the United States. In this sense it may be seen as an alternative to the proposal that the North Warning System be relocated farther North to permit extensive coverage of the Canadian Arctic. If the total cost (perhaps in the vicinity of $1.5 billion) of a relocated NWS or a similar system on the true periphery of Canada were compared with space-based radar, it appears that the latter might provide a sounder long-run solution to national surveillance in the Arctic. Political reality, however, dictates otherwise. The commitment to the first phase of the NWS has been agreed by both parties; and in contrast to the NWS agreement, there could be no expectation that the USAF would want to contribute to a modest, largely Canadian SBR which held out no possibility of detecting cruise missiles. There is, however, a further prospect. Should the US Congress choose not to fund phase two of NWS (the gap filler radars), or the Administration not request the funding, the question of northern surveillance would need to be reconsidered. At that point, the case for a national, limited purpose SBR would need to be fully investigated.

VI.

COSTS AND OPPORTUNITY COSTS

The purpose of this section is to identify certain Canadian defence procurement dilemmas that emerge from the issues reviewed in the previous sections, and to explore some continental defence options which might figure in a more general debate on Canadian defence policy.

It is generally agreed that there will be a serious shortfall in Canadian defence expenditures if, between now and the turn of the century, all of the existing requirements of the Canadian Armed Forces (CAF) are to be met. The point can be illustrated from the previous discussion. The cost of a Canadian space-based radar system, deployed around 1992, might be around $1.5 billion. The cost of a limited fleet of AWACS (E3A version) would approach $1 billion, depending on the number of aircraft, but assuming that such a fleet would be desirable. The cost of adding more northerly NWS sites, and of operating the CF-18 at Northern bases is difficult to calculate, but it should be noted that the latter in turn would almost certainly require an in-flight refuelling capability if the CF-18 were to be an effective interceptor. Tanker aircraft are not currently possessed by the CAF.[27]

In estimating all of these costs, it is wise to bear in mind estimates of cost overruns calculated by the General Accounting Office in Washington. Their conclusion is that, on the basis of the historical record, major weapons procurement projects are likely to be 30 per cent underestimated. None of the capital expenditures identified above, amounting to $3 billion or more, are currently authorized for the CAF and, presumably, none are fundable under the current long-term DND plans. Finally, it will be noted that the above deals with only one area; as demonstrated below, the analysis of maritime options for Canada would produce an equally long list of unfunded but apparently desirable procurement requirements, as might a similar assessment of the needs of the CAF in Europe.

Any larger assessment of the relative importance of Canada's commitments to continental defence as compared with its European commitments is beyond the scope of this paper, but awareness of the opportunity cost involved in committing greater resources to North American defence suggests the importance of first re-examining conventional assumptions and accepted arguments. In the case of continental defence, it is par-

[27] The short range of the CF-18 suggests that it is not the best interceptor for northern basing. It is also unlikely that the on-board radar would be sufficiently powerful to allow the pilot to re-locate a cruise missile which had been briefly detected by the NWS. In the recent competition for the USAF continental defence interceptor, the CF-18 was not entered. Interestingly, an improved version of the F-4, an older but much cheaper aircraft which was discussed but not seriously considered in the Canadian CF-18 purchase, was the first choice of the US Air National Guard, the intended operator of the new interceptors. The F-16 A was the final choice of the USAF.

ticularly noticeable that hitherto accepted political claims, which generally combine statements about national sovereignty and the need for greater defence effort against the threat from the Soviet Union, are seldom subject to rigorous questioning. It is not difficult to create a long list of contentious questions. For example, is it the case that the current inability of Canada to monitor military traffic in the Arctic — which is likely to continue — seriously prejudices Canadian sovereignty in general and claims to Arctic sovereignty in particular. If so, can the linkages be specified? Does the passage of submerged submarines through the North-West Passage, assuming some or even all of them to be US, seriously damage Canada's *legal* claim to sovereignty? If the USAF, operating primarily from Alaska and Greenland, were to conduct routine operations in the Canadian Arctic, using AWACS and F-15s, possibly without Canadian knowledge and in any case without any independent Canadian participation, what specific consequences would follow which would adversely affect Canadian interests, assuming that prior approval were requested and granted? Is it feasible for the Canadian Government to take the position that only *warning* of cruise missile attacks is required, thus insisting on the traditional distinction between warning as an essential element in deterrence, and active defence? And what would be the political implications of such a position if the Canadian Government were to decide not to pursue the Northern basing of CF-18s, and to advise the United States that it will not permit the basing of USAF F-15s in Canada even on a visiting basis? If, as was implied earlier in this paper, the diminishing contribution of Canada to continental defence leads to less knowledge about the defence of the continent and the related military activities of the United States, how important is that to real Canadian security interests and to the peacetime control of national territory? This question springs from the thought that since the ultimate calamity is hardly at issue — in reality no Government has taken seriously the question of how to defend Canada once a nuclear war begins — what situations short of war are at issue?

Whatever the answer to the last question, issues concerning military deployments in the Canadian North introduce a relatively forgotten element into the Canadian defence debate, namely domestic political requirements. A Canadian Government which rejected its nominal responsibilities for asserting a Canadian military and governmental presence in the Canadian Arctic is likely to find itself in serious electoral difficulty. Although the inability of Canada to monitor its northernmost territories can be finessed in some degree by stressing co-operative measures with the United States, the previous analysis implies that greater military resources will need to be committed to Arctic surveillance if Canadian claims to control are to be credible. In effect, much of this paper has addressed issues, including trends in bomber and cruise missile developments, emerging surveillance technologies, and ASW which all point to the increasing use of the Arctic for military purposes. Indeed, without Canadian participation, it is scarcely farfetched to envisage a future in which a wide band of the Canadian Arctic became, *de facto*, the exclusive area of military operation of the United States. The dilemmas of

Arctic surveillance and security, therefore, must be squarely faced, and will surely be at the centre of the Canadian defence policy review, for until the requirements of continental security are dealt with, it is difficult to see how the NATO pieces of the Canadian defence puzzle can be put in place.

In regard to surveillance of airspace, therefore, it seems evident that the limited capability to monitor the northernmost areas of Canada now lies with the United States. To establish a greater national capability, Canada must either extend the NWS, acquire AWACS, or initiate an SBR programme. Of these choices, and given that initial decisions about NWS have already been made, the immediate option is to extend the NWS if that is a technically feasible course of action.

To deal with the possibly more serious problem of increasing submarine use of the Canadian Arctic, it is clear that the factors affecting major defence procurement issues need to be clarified. Of these, the crucial one is whether Canada should acquire a capacity for under-ice operations. Here a distinction should be made between an active and a passive capability. An active capability requires the purchase of ice-capable submarines, since submarines are the only platform able to seek out other submarines which are themselves operating in the deep Polar basin, in the marginal ice zone, or in the ice-covered waters of the Canadian archipelago. Since, at present diesel submarines are inherently limited in their ability to operate under ice for extended periods of time, the need for an under-ice capability leads inexorably to consideration of nuclear attack submarines.

If Canada were to consider such a purchase, it would presumably not design its own, but buy them off the shelf. There is only a limited range of options. In the United States, the present Los Angeles class SSNs cost in the order of US $800 million each. The new US Seawolf (SS-N-21) is reputed to cost US $1.3 billion, with follow-on submarines at around US $1 billion. This is obviously too expensive for Canada. The British Trafalgar class submarine is much smaller than the Los Angeles class but it is considered to be competitive, and comes at a much reduced price (around US $300 million per unit). And the French have produced a still smaller submarine, the Rubis, which may cost around Cdn $350 million per unit, at which point the price starts to be comparable with that of the unit cost of the Canadian patrol frigate programme.[28]

[28] The conversion of the Poseidon from the SSBN to SSN role has been proposed and is a matter of some debate in the United States. In a curt response to a Congressional request for a feasibility study of the cost of the conversion, Secretary of Defense Weinberger agreed that technically the Poseidons could be converted to SSNs or cruise missile submarines, but that cost and military effectiveness militated against it. (See *Defence News*, Monday May 26 1986; *Defense Daily*, June 11 1986 and the *Washington Times*, June 11, 1986 for a discussion of this issue). On the matter of cost, the *Trafalgar* is not in dispute, but estimates of the *Rubis* vary considerably. William Winegard, Chairman of the House of Commons Committee on External Affairs, has implied that the Rubis cost could be around $350 million, presumably per unit copy (Speech to the Highland Fusiliers, Kitchener 13 November 1986); James Bagnall, *Financial Post*, 15 December, claims that the unit cost is $400 million per copy.

It would be inappropriate here to attempt a true operational analysis of the relative merits of these purchases. It is evident, however, that many of the same considerations that affect decisions about surveillance systems also apply. For example, progress in quieting Soviet submarines (to say nothing of the U.S state of the art) would be a major factor in considering nuclear submarine purchases.[29] Whether the British and French Governments would be willing to reveal such highly sensitive information in response to a general expression of interest to purchase would no doubt be an open question. More broadly, there is the danger that Canada might enter an Arctic contest with equipment purchases made at a great cost, only to be immediately outmatched by the technological progress of the superpowers.

Nor could it be assumed that, other than the U.S Seawolf or the later types of Los Angeles class, it would be possible to purchase off the shelf without making major and costly modifications to improve the ice-capabilities of the smaller nuclear submarines. Nevertheless, the purchase of nuclear submarines would perhaps provide Canada with its only opportunity to acquire a limited number of boats and achieve a three-ocean navy, particularly since nuclear submarines would have the capability to ply all three oceans in a single patrol.

The alternative is to buy larger numbers of cheaper but highly capable diesel submarines whose main activity would be patrol on the East and West coasts, but not in the Arctic. Not all commentators dismiss the potential of the diesel in ice conditions, and some have even suggested that extended patrol under ice could be achieved by combining diesel power with the small 'Slowpoke' Canadian nuclear reactor. In this proposal, a standard diesel submarine of, say, German or British design would be modified and probably expanded to take the low power reactor, which would allow under-ice operations for extended periods of time at very slow speeds.[30] It is doubtful, however, if this constitutes a realistic compromise for Canada. First, the hazards of under-ice operations demand wide safety margins which may not be available in a modified diesel submarine. Second, as with space-based radar, the unforeseen problems of an independent weapons development programme weigh heavily in a context where budget pressures allow little room for experiment or misjudgement.

[29] For an authoritative but much deleted survey of trends in Soviet submarine technology, see the U.S House Armed Services Committee, Hearings before the Seapower and Strategic and Critical Materials Subcommittee (HASC 99-33), 1985, pp. 134-153. For a provocative assessment, see Capt. J.E. Moore, Foreword, *Jane's Fighting Ships, 1985-86*.

[30] For a discussion of the 'slowpoke' option, see Commander E.J.M. Young, "Submarines for the Canadian Maritime Forces", *Canadian Defence Quarterly*, Summer 1986, pp. 25-36.

Given the cost, a decision to buy nuclear submarines would possibly pre-empt follow-on purchases of the Canadian Patrol Frigate, including, perhaps, the cancellation of the programme after delivery of the first six. It would be a decision likely to produce considerable debate, however, since at best it might leave the Canadian navy in 1999, say, with 10 surface ships, four of which were at the end of their useful life — and six to ten submarines. An alternative, therefore, is to emphasize *passive* detection systems in the Canadian Arctic with stronger declaratory positions on the use of the waters of the Canadian archipelago. There seem to be few, if any, experts who disagree with the proposal that, given the relatively few navigable channels into the waters of the Canadian Arctic Archipelago, a passive acoustic surveillance system could be easily developed and quickly installed. It might also be supplemented by ice-penetrating sonar buoys dropped by aircraft. If passive detection under ice is feasible at relatively low cost, the need for ice-capable (i.e. nuclear) submarines would take a different turn: in effect, the requirement would be for active wartime engagement of Soviet SSNs and SSBNs, presumably in co-operation with the United States, and with the implication that Canadian nuclear submarines would reinforce the forward strategy of the US navy.

Alternatively, if the result of passive detection systems were to provide the Canadian Government with full knowledge of the use of the Canadian ice-covered waters by foreign submarines, the position of the Government would then be comparable to that of Sweden, which has been able to detect many encroachments in Swedish waters, but, for obvious reasons, has been unwilling to risk the international incidents that would follow if Swedish ASW forces were to destroy intruding submarines in their effort to force them to the surface. In this respect, however, the Canadian Government may have a stronger hand. There may be powerful reasons on all sides to put an end to the increasing use of the Canadian Arctic by military vessels. From the point of view of the United States, and as discussed in section III, reassurance that Soviet SSNs were neither patrolling within the Canadian Arctic waters armed with long-range SLCMs, nor transiting to the Atlantic, would be a valuable contribution to the US defence effort. It would be particularly so in time of crisis, when it would be especially important to know whether there was an increase in submarine traffic to stations from which SLCMs could be used. In exchange for this the United States would give up the use of Canadian Arctic waters for purposes of transit to the Polar Basin and hence the Norwegian and Greenland Seas.

Such a policy would, in effect, constitute the unilateral declaration of a 'peacetime submerged vessels keep-out zone' in the waters of the Canadian Arctic. As such, the success of the zone would lie in the perception on all sides that it was mutually valuable. Enforcement in time of crisis, however, would not be impossible. The mining of the channels could also

be achieved at relatively low cost,[31] and probably in such a manner that the risks to the submarine would be sufficiently great to act as a powerful deterrent to violation of the zone. Moreover, to return again to the Swedish dilemma, mining as a deterrent would transfer the decision-making quandary entirely to the violator: it would, in effect, be an intruder activated system in which a fateful episode could be triggered only by the trespassing submarine. And finally, it would be only a peace-time zone: in times of crisis, the Canadian Government would remain free to support US naval efforts in any way that it considered appropriate, including allowing the United States unfettered use of the waters of the Archipelago.

In the context of traditional Canadian defence policy, such a policy is unusual but not bizarre. It would not affect the essential alliance relationship with the United States, but it would provide a constructive response to the basic problem which has been considered in this paper, namely the need for Canada to contribute to the conditions of stable deterrence, to ensure that Canadian policy is not prejudicial to the basic security requirements of the United States, but, if only for reasons of scarce defence resources, to avoid becoming involved in programmes designed to ensure the survivability of military assets in nuclear war-fighting environment, or designed to prosecute a 'controlled' nuclear exchange.

Finally, such a programme in the Arctic would permit greater resources to be allocated to ASW and general maritime patrol off the Atlantic and Pacific coasts, where, as noted previously, the progressive arming of the superpower navies with long-range SLCMs is likely to demand much greater surveillance capability. It would then shed a new light on the debate about the diesel vs nuclear submarine, no doubt tilting the balance in favour of the diesel.[32] For example, very general estimates suggest that, for the price of twelve minimum cost nuclear submarines (the Rubis, at, say, 400 million per unit), Canada could acquire 12 diesel submarines, add

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[31] For a discussion of mine types, see the US House Armed Services Committee (HASC 99-2), Defense Department Authorization and Overight for FY 1986, pp. 231-232; and Defence Department Authorization and Overight FY 1987, Part II, pp. 405-406. See also FY 1979 Arms Control Impact Statements (US GPO, Washington 1978) pp. 175-180. The CAPTOR is "a moored, influence-activated ASW mine which launches a modified M-46 torpedo against submerged submarines while rejecting surface targets." The effectiveness of mines of the CAPTOR type, which rely on acoustic homing devices, might be undermined by Soviet improvements in quieting, since the less distinctive the acoustic signature, the more indiscriminate may be the firing programme of the mine. It may also be difficult to activate and de-activate mines under ice, although in this regard there appear to be new possibilities with ice penetrating blue-green laser signals, which would allow real-time communications to the mobile mine. See *Tech Trends International*, 26 May 1986, "Arctic Tests Confirm Blue-Green Laser Communication Possible Including Subs".

[32] In the considerable literature on nuclear vs diesel submarines, perhaps not surprisingly US naval experts tend to favour nuclear while those from other NATO countries make a stronger case for the diesel. A fascinating case for Canadians, however, is the Australian submarine procurement decision, on which see P. Lewis Young, "Australia's New Submarine Project: Will Asean Navies Opt for the Same?", *Asian Defence Journal*, September 1986, pp. 4-18.

new locations to NWS, begin a satellite reconnaissance programme, acquire passive detection systems for a Canadian Arctic SOSUS, and develop a mine-laying capability adequate to the relatively small-scale requirements of the Arctic.[33] To employ the distinction made earlier, however, none of this would allow Canada to operate in the Arctic Ocean, although we can assume that even here passive detection would be possible. In pursuing this option, Canada would effectively draw the line at its territorial Arctic boundary, and accept that naval activities in the Arctic Ocean would be left to the superpowers to manage.

[33] This assumes that the unit cost difference between the lowest cost nuclear submarine (the Rubis) and a state-of-the-art diesel submarine may be as much as $200 million per copy; that an Arctic SOSUS and minelaying capability might be approximately $300 million; that, following the argument of Beattie and Greenaway (footnote 25) net additions to the NWS system would cost approximately $300 million; and that, beginning in the 1990s, following the calculations of Collins (footnote 26), a space-based system could be developed at a cost of $300 million per annum over five years. (Of course, putting the options in this way depends entirely on a final determination about the number of nuclear submarines envisaged.)

VII.

CONCLUSIONS

As is evident throughout this paper, the combination of the technological change, the search for new strategic doctrines, and the President's support for a strategic defence against ballistic missiles, has produced a situation of uncertainty in bilateral continental defence relations which is likely to continue for at least several more years.

In particular, the surveillance and interception technologies relevant to air defence seem likely to improve dramatically in the next decade, but, given the potential of cruise missile and stealth technology, so also will the threat from nuclear weapons delivered by air breathing machines. The speed and scope of change are subject to a variety of technological and political factors which suggest that a number of outcomes are equally plausible. In such a situation, the logical approach for Canada, as the minor partner, might be to defer major decisions pending clarification of the technological research programmes and the strategic defence objectives of the United States. But such a strategy does not respond to the need for long lead times in defence planning, nor to the domestic political demand for clarification of Canadian policy on issues relating to national sovereignty, continental defence, the SDI, and arms control.

More so than at any time in the past two decades, moreover, there is an explicit link between the future of continental defence and developments in arms control. As the analysis of the Geneva and Reykjavik arms control proposals indicated, lower overall ceilings with a separate ceiling on bombers could impell the Soviet Union into a major strategic bomber building programme which would, in turn, accelerate the search for new technologies of air defence. The same is true of cruise missile developments, where the lack of constraints on SLCMs provides a particularly obvious opportunity for unregulated expansion of the superpower inventories. Similarly, amendments to the ABM Treaty, the interpretation of its provisions, or even its abrogation, would have major effects on the United States, and possibly, therefore, the bilateral approach to continental defence. In this connection, some plausible future scenarios for strategic defence are fundamentally at odds with long-standing Canadian arms control policy. For example, the testing in Canada of sensors, such as the Airborne Optical Adjunct or Braduskill, which violate, or are alleged to violate, the ABM Treaty, will pose acute problems for Canada. In political terms, sooner or later, these problems will require forthright Canadian statements on the place of strategic defence in the calculus of deterrence, and on the value of arms control restraints.

In turn, the complexity, uncertainty, and impact of the issues requires substantial long-term planning of a kind not yet practised by the Canadian Government. For example, developments in space based surveillance technologies require a co-ordinated policy drawing on a number of government programmes and departments, including the proposed

Canadian Space Agency as well as more familiar departments such as External Affairs, National Defence, and Science and Technology. Although individual departments may engage in their own long-term programmes, there is no evidence that the Government as a whole has developed a capability for long-term *policy* (rather than programme) analysis. In addition, the adequacy of bilateral mechanisms for consultation and discussion with the United States might also be fruitfully reviewed. The process of consultation and policy formation which produced the NWS decision appears to be an interesting case in point, for the criticisms which have been made since suggest that the decision-making process failed to address all the relevant Canadian considerations.

To turn to more specific issues, it is clear that decisions involving new technologies such as space-based radars and submarine programmes will place great strain on the existing and projected levels of Canadian defence expenditures. If proportionately larger allocations of defence funds must be directed towards continental defence, certain broad foreign policy implications are inevitable. Specifically, Canada may be unable to commit forces of any significance to Europe *and* to enter into very costly programmes in North America. The political interest in maintaining the broadest possible allied forum for inter-governmental consultation and policy-making now contrasts sharply with the military and economic factors drawing Canada into a North American, continentalist defence posture.

This paper has suggested an approach to continental defence issues which might provide a guideline for dealing with the mounting pressures to pursue defensive technologies against aircraft and cruise missiles. It is, in effect, to limit Canadian involvement to activities which would provide peacetime surveillance and crisis stability, and to desist from programmes which, in the last resort, assume nuclear war-fighting. Hence, for Canada, non-survivable strategic surveillance systems should be considered acceptable, while the move towards survivable air-based or defended space-based surveillance systems should not be considered a high priority for scarce resources. Similarly, active continental defence against cruise missiles, implying an ongoing wartime nuclear exchange, should be avoided by Canada, but a modest northern-based capability to prevent peacetime intrusions should be given high priority. And in regard to submarines and maritime surveillance, a capacity to contest the unfettered use of the maritime approaches to Canada would be pursued energetically, but the acquisition of a capability to support the United States in a forward strategy aimed at the defeat of Soviet SSBNs in their protected sanctuaries would be foregone.

If such a vigilant but 'pre-war' doctrine were developed, it is then possible that the choice between continental and European commitments could be reconciled without requiring unrealistic increases in the Canadian defence budget. A 'pre-war' doctrine would also meet the requirements of Canadian sovereignty, but leave open the issues that would be raised if future US developments pointed towards large-scale US deployments in

Canada. Here there is some modest possibility that arms control measures might help. Unilateral measures, such as the proposed keep-out zone in the Canadian Arctic, would constitute a major break with traditional Canadian policy but might also signal Canada's determination to refuse to passively accept the militarization of the Canadian Arctic. Failing such measures, Canada might be faced progressively with more unpalatable choices. The legitimate interests of US security will always elicit a sympathetic response from Canada. On the other hand, the *de facto* development of the Canadian Arctic as a zone of unilateral US military activity will surely be rejected. The challenge facing Canada is to devise policies which protect Canadian sovereignty, respond to legitimate US security needs, and make a contribution to the stability of the superpower relationship in the circumpolar Arctic. It is this theme that one would expect to find at the core of the next statement on defence policy, as the Canadian Government considers policies designed to contribute to a stable security environment in the twenty-first century.

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